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ENGELMANN SPR
BARK BEETLE CONTROL PROJECT

COLORADO
1950

U.S. Department of Agriculture

Forest Service
and
Bureau of Entomology and Plant Quarantine

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MISSOULA
FOREST INSECT
LABORATORY

FOREWORD

The completion of the 1950 Engelmann Spruce Bark Beetle Control Project concluded the initial step of a program to save billions of board feet of timber in the national forests of Colorado.

This Project was handled by 2 agencies of the U. S. Department of Agriculture: the Forest Service provided operating administration; the Bureau of Entomology & Plant Quarantine provided technical assistance in all phases of control. Inasmuch as practically the entire infestation was on national forest land, there were no cooperating land management agencies.

The splendid accomplishments on this Project are due to the fine spirit shown by all personnel assigned to it. Regular Forest Service employees detailed from many parts of the United States worked untiringly to perfect an organization which achieved or exceeded every objective on schedule.

Special credit should go to Project Director Paul H. Roberts and to Dr. Noel Wygant and his staff of the Bureau of Entomology & Plant Quarantine, Fort Collins Forest Insect Laboratory.

The Forest Service appreciates the splendid cooperation of the Department of Defense in making Army vehicles available for the Project. Satisfactory equipment could not have been obtained from any other source in the limited time available.

The regular Forest Service employees, who carried increased workloads while others were absent on detail to the Project, also deserve a large amount of credit. It was a Service-wide Project, although the work was actually performed in the high elevation spruce forests in Colorado.

Edward P. Cliff

EDWARD P. CLIFF
Regional Forester

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ABSTRACT

Events leading up to the Colorado Spruce Beetle 1950 Control Project began in June, 1939, when high winds caused a heavy blow-down of Engelmann spruce timber on the White River Plateau in western Colorado. The large numbers of down trees formed a perfect host condition allowing a tremendous build-up of the normally endemic Engelmann spruce bark beetle to what was recognized as an epidemic condition in 1941.

Although the need for control was recognized, there was insufficient detailed knowledge of the beetle's life history on which to base control techniques. The war years intervened until the epidemic had spread to such proportions as to constitute a threat to a major portion of the 19 billion board feet of Engelmann spruce timber in Colorado, plus additional amounts in southern Wyoming and northern New Mexico.

Investigation of the beetle's life history was started in 1944, and in 1949 came the break which made 1950 the strategic year in which to make an attack on it. High winds spread the population to new areas. Natural enemies were at their highest effectiveness. The spread constituted an even more potent threat to all the Engelmann spruce timber of Colorado. It was evident that if the beetle was to be stopped, the opening battle of the campaign must be in 1950.

Planning and surveys were begun in the late summer of 1949 and continued through the winter and spring of 1950. An appropriation of $2,885,000 was requested. $2,000,000 was finally appropriated in late June, 1950.

The 1950 Control Project, although handicapped by a late start and insufficient funds, accomplished the major part of its planned objective, which was to kill the beetle brood in trees attacked in 1949 along the eastern and southeastern fronts of the infestation. When the 1950 Project closed in October, a total of 784,082 beetle-infested trees had been found and treated.

At the time the Project was proposed, it was recognized and pointed out that the 1950 Control Project could be only the opening battle of a campaign which must last several years to be successful.

Some control of beetles that attacked in 1950 was done during the Project, but the major portion of 1950 attacked trees was not treated, and they still harbor healthy beetle larvae which, if uncontrolled in 1951, would emerge in 1952 to continue spreading the infestation to all the timber threatened before the 1950 Control Project.

The 1950 Control Project made a tremendous reduction in population of the beetle brood which would have attacked in 1951. A project of adequate proportions in 1951 would similarly decimate the beetle brood that could attack in 1952.

APPROPRIATION

Based on numbers of trees indicated by the Bureau of Entomology & Plant Quarantine 1949 survey, and cost of treating on the Basalt Mountain test control project in September 1949, it was estimated that $2,885,000 would be required in 1950. At a conference, November 30 - December 2, 1949, in Washington, D. C., among representatives of Forest Service, Bureau of Entomology & Plant Quarantine, Park Service, and Bureau of Land Management, it was agreed that the full control job at that amount would be recommended. A request for deficiency appropriation was submitted by the Department of Agriculture to the Bureau of the Budget during December, 1949.

Since nearly the entire infestation was on Federally-owned lands, there was no possibility for any cooperative funds. The entire cost had to be met by the Federal Government.

The President of the United States on January 27, 1950, requested Congress to appropriate $4,500,000 Forest Pest Control Funds which included $2,885,000 for the Colorado Spruce Beetle Control Project.

In March, Congress passed the Urgent Deficiency Bill, which did not include the funds requested for the Colorado Spruce Beetle Control Project, but Appropriation Committee members of both the House of Representatives and the Senate gave assurance they would consider this item in the next deficiency measure.

On May 15, Representatives Aspinall and Carroll of Colorado introduced a joint resolution requesting approval of a special appropriation for the Colorado Spruce Beetle Control Project. A few days later the Second Deficiency Bill was reported out of the House Appropriations Committee without funds for the Colorado Project. The House passed this Bill on May 22, after defeating a motion by Representative Aspinall to include such funds.

By this time, favorable public opinion had been aroused, and interested individuals and organizations continued efforts to obtain an appropriation. On June 23, a Conference Committee reported out the Second Deficiency Appropriation Bill with $2,000,000 included for the Colorado Spruce Beetle Control Project. On June 27, this Bill passed both Houses and was signed a few days later by the President.

PROJECT PLANNING

Planning for the 1950 Project started on September 2, 1949, when a decision was made to run a test control project on Basalt Mountain, White River National Forest, to gain experience in control methods, organization problems, and costs.

On January 31, 1950, supervisors of affected forests were requested to submit organization plans and equipment needs on the basis of handling control on a forest project basis. A number of meetings of

these supervisors and members of the regional office were held during the winter months for further discussions.

On April 18, C. T. Brown and Paul McCord were assigned to full-time planning at the Forest Service Regional Office, and on April 26, Mr. Paul H. Roberts arrived at Denver to assume duties as Project Director. Soon after, a number of other individuals were assigned to Project planning in the Regional Office.

After thorough discussion, it was agreed that the Project would be handled as a regional office Project under the Project Director. The Project was divided into 2 areas, each to be under the direction of an area supervisor, with headquarters at Eagle and Kremmling. Forest supervisors and rangers were to act in an advisory capacity to make available their knowledge of local conditions. The organization is shown in charts in the Appendix.

Camp sizes were standardized at 33 and 66-man camps to fit packaged outfits available on transfer and purchase from Region 1. These were later changed to 37 and 74-man camps for planning purposes and, in the field, actually became as large as 55 and 100-man camps by addition of necessary tentage, beds, bedding, and mess equipment.

Field investigations in the spring of 1950 made it apparent that the Rabbit Ears infestation had spread further north and contained more infested trees than originally estimated. This, combined with delays in congressional action on appropriations, led to a decision on May 12 to eliminate control in this infestation from the 1950 program.

Later, when it became apparent that a $2,000,000 program would be financed instead of the requested amount of $2,885,000, still further downward revision of the planned program was necessary. On June 26, a revised budget was prepared omitting all but 1 camp on Red Table Mountain, and that one camp to be on a deferred basis until after an opportunity to test costs. Red Table Mountain was selected as the best place to defer 1950 control on the basis that it would not only be a costly operation per tree treated, but that the area still contained ample green spruce to absorb the 1950 and 1951 attacks with a minimum spread outside the presently infested area.

This sort of strategic replanning was required throughout the Project's life. Continued reconnaissance and survey disclosed new infestations and led to a constant analysis of the control program.

Policies on which strategy was based were to treat all 1949 attacked trees in all infestations in which any control work was done, to treat no 1950 attacked trees at the sacrifice of 1949 attacked trees, and to normally treat no lodgepole pine. Such policy was necessary to trim the Project pattern to the financial

cloth. An exception to treating all 1949 attacked trees was on Castle Peak, where the objective was to treat as many as time would allow.

On July 11, in a meeting at Kremmling attended by representatives of the Bureau of Entomology and Plant Quarantine and the Forest Service, it was agreed that the recently investigated Williams Peak infestation should be treated in preference to the less critical Black Lake and North Rock Creek infestations.

On August 5, at a conference in Denver, it was agreed that the deferred Red Table camp could be financed and was to be occupied as soon as possible. Castle Peak infestation was discussed, and the Bureau of Entomology and Plant Quarantine was requested to make an immediate survey.

On August 26, it was agreed that the Castle Peak infestation would be controlled to the extent possible, and the camp was established immediately. At this same meeting, the Elk Mountain infestation was discussed and, because of its size and threat, was added to the program.

PROCUREMENT OF EQUIPMENT, SERVICES AND SUPPLIES

Difficulties experienced in starting this Project, as the result of uncertainty and delay in receiving funds, were especially noticeable in the field of procurement.

Anticipated requirements of burner oil, orthodichlorobenzene, pump hose, jeep cans, and all major items were compiled during February and March of 1950. Commercial sources were contacted to determine availability, and tentative commitments were made dependent upon availability of funds. These commitments could not be retained, however, because of the long delay in receiving funds.

Quantity buying was difficult because items were purchased for 2 camps initially, then 4 more and, finally, after the Appropriation Bill passed, for the remaining 7 camps.

Orthodichlorobenzene was an especially difficult item. In February, replies from known distributors indicated availability of a sufficient supply. By the middle of May, however, the situation had entirely changed, and it appeared that Project needs would be short by 100,000 gallons. It was found that the United States Air Force at Wright Field had purchased a sizeable quantity of orthodichlorobenzene for use as a degreasing agent. Through the cooperation of the Air Force and the Dow Chemical Company, contractor, a portion of this supply was diverted to the Forest Service; also a supply of a commercial grade product was located. This was high in paradichlorobenzene content and held quantities of a tar residue which came out of solution when mixed with burner oil. It was necessary to arrange for settling and filtration by the oil contractor to eliminate this tar residue. Because paradichlorobenzene crystallizes at temperatures up to 127° F., it was necessary to add a sufficient quantity of

orthodichlorobenzene with a low para content to obtain a chemical with not less than 50 per cent of orthodichlorobenzene. Such a chemical, when mixed with burner oil, will only crystallize at low temperatures. A total of 154,000 gallons of orthodichlorobenzene was finally purchased from various sources.

After close study, it was decided to contract the purchase of burner oil, mixing and storing at Denver, and delivery to area ortho depots at Eagle and Kremmling. Although there were a few delays in delivery to ortho depots, this contract proved to be very satisfactory. Delivery from Denver to the depots was made by a private contractor in large tank trucks. This proved cheaper than railroad freight.

The problem of a hose that is satisfactorily resistant to ortho was not completely answered on the Project, although one plastic hose tested near the close of the Project showed promise.

Pumps used were the bucket or stirrup pump as manufactured by the D. B. Smith Company and the F. E. Myers Company. These pumps were not intended for constant use, and frequent repairs were necessary to keep them in operation. This problem is being studied to determine whether economical means of strengthening the pump can be developed.

Portable shower buildings, mess halls, meat houses, and latrines were constructed by force account at a considerable saving over any contract figure. Shower buildings were fabricated at the Forest Service Denver Warehouse, and other buildings at Kremmling. Subsistence was contracted at $2.80 per day per man. There was a different contractor for each area. These contracts operated exceptionally well and saved money, as well as relieving area offices of the multitude of details involved in operating a Government mess.

Horses and pack equipment were contracted to one individual for both areas. This contractor did not provide a completely satisfactory service, but the packing was accomplished at a considerable saving over the estimated cost of purchasing and feeding pack stock by the Government.

AUTOMOTIVE EQUIPMENT

The terrain in which this Project operated was rough and steep, and the native road material was subject to becoming slick and soft when wet. For these reasons, it was agreed that hauling equipment should be all-wheel drive rather than conventional.

Realizing that the needed equipment would be unobtainable by purchase because of cost and probable delay in delivery far beyond dates on which it must be available, efforts were started early in the planning stages to obtain a loan of 6x6 trucks, weapons

carriers, jeeps, and jeep trailers from the Department of Defense. Such a loan on a rental basis was eventually negotiated.

All available, suitable Forest Service-owned equipment was placed on the job, and some surplus equipment was procured from other Government agencies.

The following tabulation shows the number and source of motor equipment used:

Source	6x6	Weapons Carriers (1)	Jeeps	Jeep Trailer	Carry-alls	Pickups (2)	Comm'l Recon	Panels	Stakes	Sedans	Total
Army	38	75	73	31							217
F. S. R-4		6	11								17
F. S. R-2		6	11			17		2	12	5	53
Los Alamos (3) A. E. C.		13	13								26
El Reno (4)	4	4									8
Ft. Robinson (4)			1		2		1				4
Totals	42	104	109	31	2	17	1	2	12	5	325

(1) Includes Power Wagons insofar as Forest Service Equipment is concerned.
(2) Includes Jeep 1 T. trucks.
(3) Purchased
(4) Surplus

The 6x6 trucks were used primarily for hauling ortho and other heavy supplies from ortho depots to camps. They were not assigned to camps in any case, since more effective use could be made by keeping them under control of area dispatchers. There was barely enough of them for the job, and at times a few more would have provided desirable flexibility.

Power wagons and weapons carriers were used for transporting ortho to the farthest points to which motor transport delivery could be made, and for personnel carriers.

Jeeps were used for personnel carriers, overhead, road location crews, and Bureau of Entomology & Plant Quarantine survey crews. They proved to be too light in body construction for hauling ortho. Jeep trailers were not used as extensively as had been anticipated.

Pickups were mainly used for area headquarters and ortho depots personnel and in connection with road construction.

Two sedans were used by area supervisors and 3 by the regional office.

Maintenance was handled by a repair shop at each ortho depot. Field repairs and servicing were by mobile units operating out of ortho depots. The Forest Service Shop at Grand Junction did heavy repairs which ortho depot shops were not prepared to handle.

ROADS

Perhaps the most important phase of solving logistical problems of the Project was the road system required to transport men, equipment, and ortho into the rough and inaccessible areas where the major portions of the infestations were located.

Prior to April 19, 1950, not a single location stake had been driven. Between that date and the end of September, 388 miles of roads were located and constructed, with actual construction starting on June 13.

Road construction and location were done under direction of the area supervisors, with a representative of the Regional Office, Division of Engineering acting as liaison officer and consultant. In each area headquarters, 1 man was placed in charge of all road location, construction, and maintenance. Experienced road locators were detailed to the Project, and some temporary employees were used after a period of training.

By far, the major portion of both construction and maintenance was accomplished through use of privately-owned equipment contracted for at hourly rates which included operator, fuel, lubrication, and maintenance. This arrangement proved very satisfactory. It was probably the only approach, since Forest Service equipment of types required could not have been made available within time limitations or at a comparable cost.

Privately-owned equipment consisted of 12 D-7 or TD-18 tractor trail-builders, 11 D-8 tractor trail-builders, 2 D-6 class tractor trail-builders, 8 motor patrols of the Caterpillar 12 class, and 2 carryall scrapers.

Forest Service-owned equipment consisted of 2 rippers, 2 truck-mounted compressors, 3 carryall scrapers, 1 truck-mounted 1/4 cubic yard capacity shovel, 1 dump truck, and 1 TD-9 tractor trail-builder. Miscellaneous pickups and stake trucks were also used.

AREA HEADQUARTERS

Organization was similar on the 2 areas, with the exception that on the Eagle Area, the area supervisor, assistant area supervisor, and the administrative assistant and his staff were located at Glenwood Springs, about 20 miles from the ortho depot at Eagle; whereas, all area headquarters personnel on the Kremmling Area were located at Kremmling. The disadvantage of the Eagle Area setup was the geographical separation of the 2 groups, making close coordination a little more difficult than at Kremmling. There was a distinct advantage, however, in not having all offices in one place as at Kremmling, where the space available was insufficient to provide privacy for the various offices, with resulting confusion and loss of efficiency.

ORTHO DEPOTS

Two ortho depots were constructed under contract, one each at Kremmling and Eagle. The Kremmling depot had three 5000-gallon horizontol steel storage tanks, and the Eagle depot had 5 such tanks. A 24'x24' steel loading dock was located alongside the storage tanks. A 2-inch iron pipe connected all tanks at each depot. These tanks were used for bulk storage of ortho. The tanks were filled by means of a gasoline-driven pump furnished by the hauling contractor.

Ortho was placed in 5-gallon jeep cans at each depot by gravity feed. At Eagle, this was accomplished by a manifold filler which provided for filling 4 cans at one time through control of a master spring valve. Cans were moved on the dock on dead rolls from the filler pipes to the dock edge.

At Kremmling, advantage was taken of the fact that the depot was on the brink of a hill with a road at the foot about 40 feet distant. 4 gasoline hoses with 1" quick-acting nozzles were attached to the filler manifold and were used to fill the bottom layer of cans directly on the truck bed at the foot of the hill. The cans for the top layer were filled on the steel dock from a fifth filler hose at times when no trucks were loading.

Both systems of operation were effective in keeping abreast of field demand.

CONTROL METHODS, EQUIPMENT, AND CREW ORGANIZATION

Treating was accomplished by hand pump application of insecticide to the bark of the infested tree bole. Insecticide used was a mixture of 1 part orthodichlorobenzene in 6 parts of No. 1 or No. 2 burner oil. This mixture is referred to as "ortho."

Ortho was transported from area depots to the woods in 5-gallon jeep cans from which it was pumped with stirrup pumps. Application of ortho

to the tree was through a specially drilled nozzle attached to a 1/4"x6' aluminum pipe connected to the pump by about 25' of ortho resistant 3/8" hose.

The nozzle was designed to throw a solid stream to a height of 30 - 35'. This characteristic is a handicap in treating lower portions of the bole due to excessive splash resulting in loss of both ortho and time. Since much of the treating was done on lower portions of the bole, this was quite important, and field personnel designed a stream deflector plate which can be flipped to one side for high treating. When in operating position, the deflector plate spreads the solid stream into a fan shaped stream which strikes the bole with little force and, consequently, very little splash. Pump pressure can be maintained at a constant level for both upper and lower portions of the bole. Tests on the job showed a saving of both ortho and treating time through using these deflectors which were manufactured on the job.

Drip from the nozzle down the aluminum pipe to the nozzleman's hands and arms was very objectionable and was eliminated by soldering a cut iron washer on the lock nut used to lock the nozzle to the pipe.

The technique of treating was fundamentally that of saturating the bark on infested portions of the bole with ortho. This was done by directing the nozzle stream to the highest portion of the bole to be treated, holding it until there was a sufficient build-up to run down the bark, and then moving it down the bole at a rate of speed which kept it just ahead of splashing back into the build-up. When the build-up had reached the duff line, the nozzle stream was held long enough to insure a run down on the bark below. All exposed roots were treated the same as the base of the trunk. After hibernation takes place, basal treatment is especially important, and it was found desirable to remove duff by a "duff scratcher" which is a stick, a small cultivating hoe, or a cultivating rake with 3 or 4 recurved tines. Such removal of duff was not essential to adequate treating, but it was desirable for the majority of crews to insure the application of a sufficient amount of ortho.

Crew organization details varied with topography, intensity of infestation, type of infestation (whether a large area, small spots, or creek bottom stringers), and amount of down timber. The personal desires of the camp superintendent also influenced the organization without necessarily influencing production, since there is generally no one absolutely correct organization.

The fundamental crew was the nozzleman and pumpman. This team was the nucleus around which was organized a balanced control crew which located and treated infested trees, maintained ortho supply, and provided checking and supervision of work. Perhaps the most commonly used control crew consisted of 7 men: 2 nozzlemen, 2 pumpmen, 2 ortho carriers with pack horses when necessary, and a spotter. The spotter located and marked infested trees, supervised and trained the 2 pump teams and their packers, and currently checked their work. This 7-man crew was changed, as necessary, by addition of a spotter in very

heavy or very scattered infestation, or an ortho packer where the haul was long or difficult, or elimination of ortho packer when the crew worked adjacent to automotive delivery routes. From 3 to 6 such crews worked under the supervision of a treating foreman who was responsible to the camp superintendent.

When Project instructions were prepared in the spring of 1950, it was anticipated that considerable difficulty would be encountered in locating infested trees by spotters and marked trees by treating crews. Rather complicated spotting instructions were prepared. Actual field experience soon indicated that direct spotting by the crew foreman immediately in advance of treating was the best method. String lines were laid out at 4 or 5-chain intervals to guide the crews. Woodpecker work was so heavy that locating infested trees was simplified. As spotters became experienced, they found no insurmountable difficulty in locating all infested trees. Since they were working only a few minutes ahead of the nozzlemen, they were in a position to check back frequently and assist in locating marked trees. It was also found that changing conditions of the beetle brood, due to woodpecker work, hibernation, etc., precluded the possibility of spotting much in advance of the actual treating.

ACCOMPLISHMENTS

Total trees treated	- 1949 attacks	619,688
	- 1950 attacks	164,394
	Total	784,082
Acres on which treating done	-	33,301
Total gallons insecticide used	-	1,003,253
Average gallons insecticide per tree	-	1.28
Total camp man-days less kitchen help	-	52,198
Average trees treated per camp man-day	-	15.02
Total expenditures to December 31, 1950	-	$1,773,155
Cost per tree	-	$2.26
Total miles roads:	-	

	New Construction			Betterment		
Area	Main Haul	Treating	Total	Main Haul	Treating	Total
Kremmling	85	124	209	18.4	6	24.4
Eagle	60	65	125	29.6	-	29.6
Total	145	189	334	48	6	54

The Project objective (except on Castle Peak) of treating all 1949 attacked trees in infestations worked was fully met. The other objective of treating a minimum of 500,000 trees was more than met.

It had been anticipated that 1950 attacks might be cleaned up in some cases, as well as 1949 attacks. This was done in some small areas, as is shown on the 1950 treating map in the Appendix, but it was not possible to clean up any large areas to the extent that a camp would not be required in 1951.

CHRONOLOGY

Field activities began on May 25, when Kremmling Area Headquarters was established by Area Supervisor Paul P. McCord, and Eagle Area Headquarters by Acting Area Supervisor C. D. Clark, pending arrival of Area Supervisor E. A. Snow.

Fabricating camp buildings for both areas was begun at Kremmling by the end of May.

First camps to be established were Basalt in the Eagle Area, and Gilsonite in the Kremmling Area on June 19. Training of key personnel started in these camps almost immediately.

With passage of the Second Emergency Deficiency Appropriation Act late in June, the program of camp establishment was stepped up to full tempo, and by July 25, 10 of the originally planned camps were established. Williams Peak Camp was established on August 1. Redtable Camp on August 10, Castle Peak on August 27, Chimney Rock Camp moved to Elk Mountain on September 6, and Williams Peak moved to Sheephorn East on September 25.

Road construction was also stepped up as soon as Project funds were available, with first emphasis placed on completing roads to camp locations so as to maintain schedule of camp occupancy dates.

In the meantime, ortho depots had been constructed at Eagle and Kremmling; a CCC barracks was moved to Eagle for quarters, warehouse, and office space; a CCC barracks was moved to Kremmling for quarters and warehouse; area headquarters for Eagle Area was established at Glenwood Springs in space made available by the White River National Forest Supervisor's office, and at Kremmling in rented space. Arrangements had been made for loan of Army automotive equipment and some Forest Service equipment. An adequate supply of orthodichlorobenzene had been located and contracted for. Contracts had been let for road construction equipment, operating camp mess, horse hire, and mixing and delivery of insecticide to the ortho depots. Labor was recruited as rapidly as camp completion warranted. Detailed key personnel arrived and assumed their duties.

Labor proved reasonably available, although the late date on which funds were received caused a loss of much of the better class of labor early in the season. It was never possible to keep all camps fully manned, and turnover was high due to the class of labor available. Castle Peak Camp was manned from the outset with Navajo Indians. The loss of labor caused by the September 9 storm was offset in part by recruitment of additional Navajo and some Hopi Indians, but it was never possible to get camps up to the pre-September 9 strength.

Weather was unusually good during most of the treating season. Spring snow melt was somewhat later than usual, resulting in slight delay in getting into certain areas, but there was much less than the normal

amount of summer rains. The fall storm arrived a little early, on September 9, and lasted for a full 2 weeks with cold weather, rains, and snows.

By the end of September, camps were completing their assigned programs, and by October 6, all treating in the Eagle Area was complete. Treating continued in the Kremmling Area until October 21.

Eagle Area Headquarters was discontinued on October 21, and Kremmling Area Headquarters on November 2.

PUBLIC RELATIONS

Between 1944 and 1949, news releases and feature articles were either prepared in the Division of Information & Education of Region 2, or material was furnished to reporters of newspapers, magazines, and wire services, resulting in the publication of many stories on the epidemic.

In 1949-1950, the same media were employed to inform the public. Plans for the Project, its inceptive stage and its final set-up and progress, were dealt with in a series of newspaper and magazine articles. In this category should be mentioned the series carried in the Middle Park Times and the series carried in the Eagle Valley Enterprise. Other articles and guest editorials have been carried from time to time in local papers, in Denver (Post and Rocky Mountain News), and throughout Colorado and Wyoming.

A series of full-length, illustrated magazine articles have appeared, beginning in September 1950, in the Timberman, Green Thumb, Look Around (in three installments), Colorado Engineer, Colorado Engineers Bulletin, Nebraska Farmer, Colorado Rancher and Farmer, and Colorado Centennial.

Several well-conducted show me trips, organized by area supervisors, showed key groups of men and women the various phases of the Control Project on the ground.

Several batches of kodachrome slides of the epidemic area have been made by various Forest Service personnel - both before and after the Project was begun - by Jay Higgins, Tom Brown, and others. Extensive series of black-and-white photographs have been made, also, by Jay Higgins, and by Messrs. Prater and Mosher, especially, who took more than 300 fine photographs in and out of the treating camps. These show every aspect of Project activity and have already been used extensively in illustrating the magazine articles indicated above.

These photographs have also been used, and will continue to be used, in panel and exhibit form. They were used recently at a regional convention of Girl Scout leaders in Denver; and about 100 of them, with appropriate

running legends, mounted on 5 large panel boards, will be set up in January for a special series of meetings, sponsored by the Colorado Forestry and Horticulture Association, being held in Denver.

Assistance was given by the Information & Education office in Denver in the early stages of preparation of a script for a complete motion picture on the Project. This picture, filmed by Messrs. Prater and Mosher, will be released for showing probably early in 1951.

HISTORY OF THE OUTBREAK

In June, 1939, winds of hurricane proportions blew down extensive stands of spruce on the White River Plateau of the White River National Forest. Engelmann spruce beetles, endemic in this area, attacked the weakened and down spruce. The broods in the fallen trees were protected from woodpecker feeding and lethal-low temperatures during the winter by snow covering. The beetle build-up was tremendous, numbers of trees attacked were overwhelming; the outbreak was on its way.

In 1941, the outbreak was discovered. Salvage cuttings in operable areas proved effective for control, but inoperable areas of blow-down in the plateau predominated, and prevailing southwest winds carried the beetles widespread into remote country on the White River and on into the Routt and Arapaho National Forests. By 1943, the epidemic had increased to such proportions that the insect showed no respect for tree size or vigor.

The seriousness of the infestation was realized, but the problem of control was very great. Methods of control were unknown; even knowledge of the insect's life cycle, which is necessary for control, was lacking, and the nation involved in World War II could not supply the necessary materials and manpower to battle the insect.

Uncontrolled, the beetle moved on northeastward. By 1949, approximately 3.5 billion board feet of spruce had fallen prey to it. At that time, it appeared that the insect apparently was heading for possible natural control through exhaustion of host material on the White River Plateau and on the north end of the Gore Range.

In July, 1949, strong northwest winds carried hordes of the beetles over the Colorado River into stands of spruce heretofore practically free of spruce beetles. Thus, to the northeast, east, and southeast, many more millions of trees were exposed to the beetle outbreak. This mass movement resulted in wide dispersal of beetles and the consequent loss of tremendous numbers in non-timbered areas. The population, although heavy enough to continue epidemic, was at its lowest in years - the opportune time to initiate control. Only intensive, artificial control barring a miraculous natural control would save most of the spruce in Colorado.

Investigations of the beetle, its life cycle, habits, and control were started in 1944 and have been continuous. Fortunately, knowledge to carry out effective control was available by the time the beetle crossed the Colorado River in 1949. Every effort was made to delineate and sample the newly-infested area to obtain information for control operation in 1950. This work revealed that it was imperative to begin control at once if the outbreak was to be stopped, and that it would need to be a continuous operation for at least 3 years. A short delay in getting started would be dangerous; a prolonged delay would mean an operation longer and larger than originally anticipated; an interruption in annual continuity of the program would mean failure.

VALUES AT STAKE

Timber values were large. Nothing in the history of the infestation or evidence on the ground indicated the spruce beetle, if left uncontrolled, would stop short of destroying a major portion of the 19 billion board feet of spruce in Colorado plus 840 million board feet in southern Wyoming and a lesser volume in New Mexico.

Volume of Timber Threatened in Colorado and Wyoming

Degree of Threat	Spruce Volume M. feet b.m.	Lodgepole Pine Volume° M feet b.m.	Total Volume M ft. b.m.
Killed by 12/1/49	3,500,000	400,000	3,900,000
Possible in near future°°	2,220,000	1,990,000	4,210,000
Ultimate probability	10,720,000	983,500	11,703,500
Totals	16,440,000	3,373,500	19,813,500

°Lodgepole pine volume shown represents 50 per cent of stand for areas threatened

°°Arapaho, Routt, White River, Gunnison, and Roosevelt National Forests.

In order to appreciate the true economic significance of the threatened disaster, volumes are converted into dollars as shown below. Conservative stumpage rates of $3.00 per M ft. b.m. for the timber and $40.00 per M ft. b.m. for economic loss of salaries, wages, services, and other items connected with cutting and manufacturing lumber from killed and threatened timber are used. Lodgepole pine has been included only for the amount killed by December 1, 1949. The volumes in the above tabulation are net. Since an estimated 40 per cent is inoperable, values have been reduced by that amount.

Values of Operable Timber (60% of Total Volume)

	Stumpage	Salaries, wages, etc.	Total
Killed by 12/1/49	$ 7,020,000	$ 93,600,000	$100,620,000
Possible for near future	3,996,000	53,280,000	57,246,000
Ultimate probability	19,296,000	257,280,000	276,576,000

Fire hazard and consequent fire control costs would be increased in direct proportion to the amount of timber killed by the spruce beetle, since the enormous quantities of dead timber would create a much more hazardous fuel type than normal green spruce forests. If a destructive fire occurred, all young growth would be lost, and the soil values seriously impaired.

Watershed values would not only be directly impaired, especially on steeper slopes, by loss of the living tree canopy, but the possibility of even greater indirect loss, as the result of a disastrous fire, is tremendous.

Recreation values would be seriously depreciated by the substitution of dead trees for living forests. The eventual mass of down and crisscrossed logs would make the areas untenable to big game, and possible fires would ruin fishing streams.

LIFE HISTORY OF ENGELMANN SPRUCE BEETLE

The Engelmann spruce beetle, Dendroctonus engelmanni Hopkins, has a 2-year life cycle. The brood spends the first winter as larvae under the bark along the bole of the tree, and the second winter as hibernating adults usually at the base of the same tree. The hibernating adults emerge, attack, and produce broods in healthy trees during June and July of the second year. These attacking beetles, having completed egg-laying, come out of the bark and hibernate a second winter in the basal portion of the tree. These parent beetles may attack green spruce successfully a second year. An abundance of beetles and a dearth of spruce result in beetle attacks of lodgepole pine. Brood production in lodgepole pine is generally unsuccessful; thus, lodgepole pine absorbs many beetles and aids in control. Hibernating parent beetles, however, will leave lodgepole to attack green spruce.

The larval brood, present from August of the first year through July of the second, is concentrated under the bark on the bole of the tree (generally to a height of 30 feet). The larval brood, therefore, is favorably located for artificial control operations wherein the technique of control provides for insecticide application to a height of approximately 30 feet. Brood above that height may be destroyed by woodpeckers. The hibernating adults, in spruce as well as in lodgepole pine, generally are present in the basal 5 feet of the bole from mid-August to mid-July of the following year. The hibernating adults, therefore, are so located that control by the technique of applying the insecticide can be successful in the fall before the snow covers the bark and after the snow has melted in the spring. Woodpeckers feed only when snow fails to cover.

WOODPECKERS

A large part of natural control of bark beetles falls within the bounds of woodpecker habits. Woodpeckers, feeding on larvae and adults of the spruce beetle, consume tremendous numbers and normally keep this native insect at endemic population levels.

The occurrence of woodpeckers in spruce areas and the build-up of their population in, and their migration to, bark beetle outbreak

areas, apparently natural things, are fortunate from the standpoint of control. Without the woodpeckers' assistance, it would be difficult to bring the project to a successful conclusion. With their assistance continued, artificial control undoubtedly will be successful.

The method and abundance of feeding, as related to beetle activities, influence the technique and extent of artificial control. Spruce beetles produce broods in the lower portions of the boles to an average height of 35 feet. The equipment adapted for artificial control permits application of the ortho to a maximum height of 30 feet. Woodpeckers feed on brood wherever it occurs on the tree, possibly preferring the upper parts of the bole; hence, chemical application gets the brood in the lower part of the tree, and woodpeckers take the rest.

The occurrence of woodpeckers' feeding is an added advantage in spotting beetle-infested trees. During a control program, it is generally the case that the woodpeckers are active in an area ahead of the spotters and treating crews. Woodpeckers, in feeding, remove much of the bark, distributing it on the ground beneath the tree and exposing fresh bright bark or wood, all readily noticeable. In these woodpecker-inhabited areas, beetle broods will not be found more than 18 inches above highest woodpecker work; thus, application of the ortho, even where woodpeckers have fed only lightly, need not be considered above that height. This, incorporated in the treating program, resulted in the saving of considerable ortho and manpower. Ortho was not applied to portions of the bole where woodpecker feeding was very heavy.

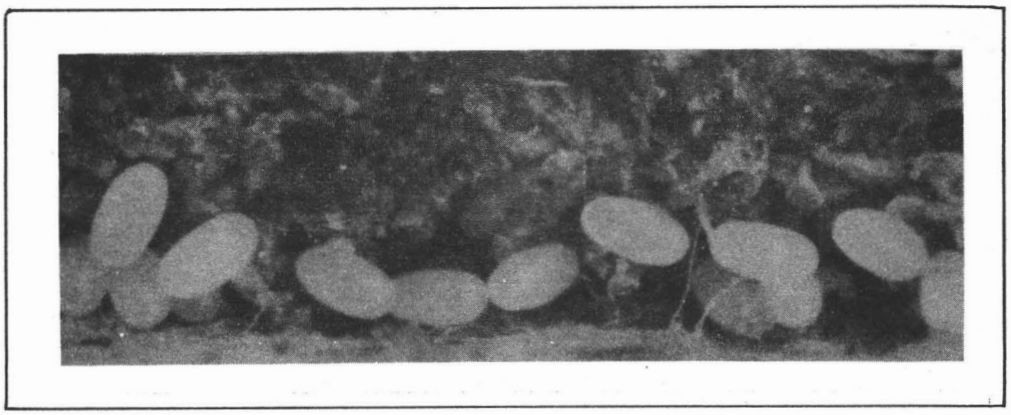
The ortho was found neither injurious nor repellent to woodpeckers.

INSECT SURVEYS AND TECHNICAL ASSISTANCE

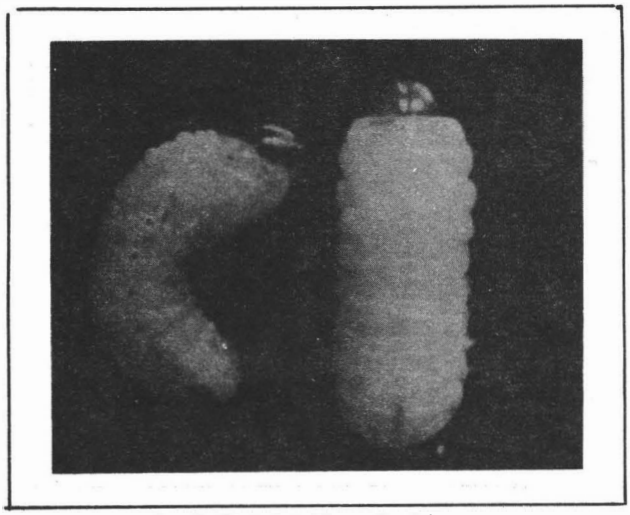
Entomological aspects of the Control Project and recommendations of chemicals and the treating equipment and treating techniques to use were the responsibility of the Bureau of Entomology and Plant Quarantine. The pilot control project on Basalt Mountain in the fall of 1949 was the initial training and testing ground. Bureau of Entomology and Plant Quarantine and Forest Service personnel worked together to formulate field procedures. The practical and the impractical pieces of equipment and methods of control were segregated.

Bureau of Entomology and Plant Quarantine personnel assigned to camps in the control areas were continuously in the field as consultants and advisers on all the entomological phases of the program. With Forest Service field personnel, they recognized new problems, developed practical answers to them, and made on-the-spot decisions. This was a never-ending, but a very necessary, job until the control operations for 1950 ended.

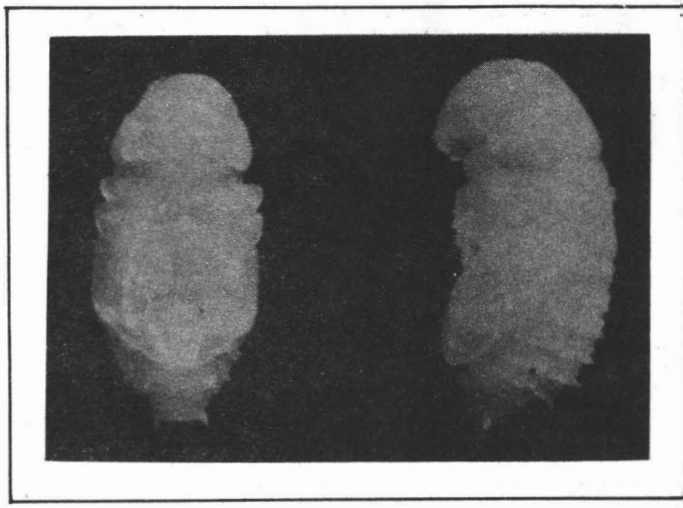
The Bureau of Entomology and Plant Quarantine initiated the bark beetle detection surveys and carried out these surveys to provide the Forest



EGGS-30X



LARVAE-8X



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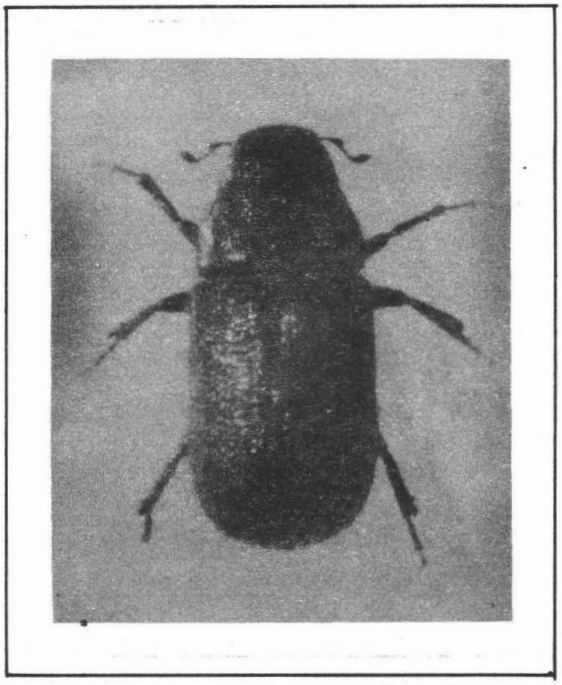
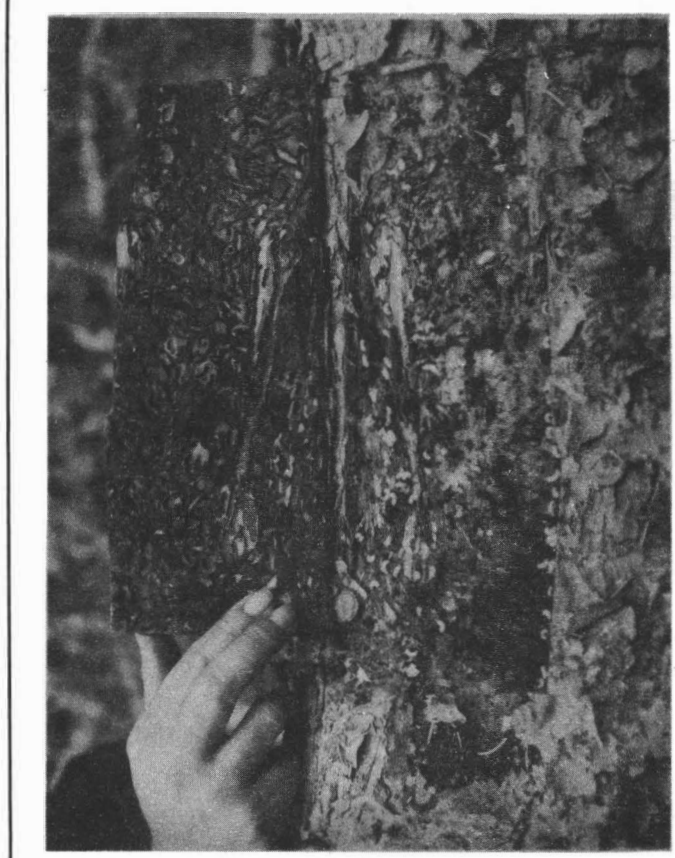


ADULT-10X

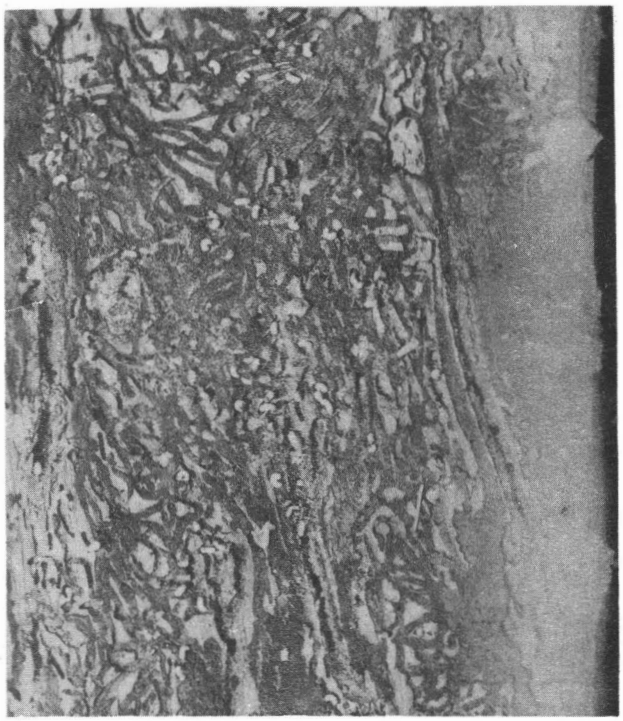
S - Insect Control (Spruce)

GPO 82-9000113

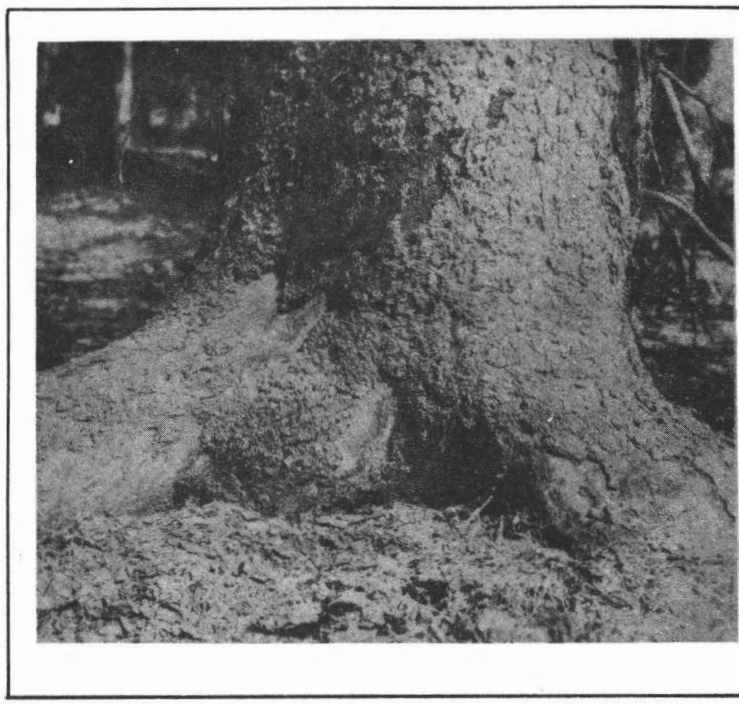
1/3 GROWN LARVAE FEEDING IN INNER BARK - 2 X



BARK REMOVED TO SHOW WORK



LARVAE & GALLERIES IN INNER BARK 0.5 X



BARK REMOVED BY WOODPECKERS TO FEED ON HIBERNATING ADULTS

S - Insect Control (Spruce)

GPO 82-9000113

Service with the pertinent information, including maps, as to locations of epidemic areas and number of infested trees in those areas.

The 1949 surveys were not only extensive but intensive. A remarkable job was done in country that was neither typed nor well mapped; many base maps were inaccurate. Approximately 64,000 gross acres were surveyed in 338 man days. The results of this survey formed the basis of the early planning phase of the 1950 control operations. The survey was continued in spring and early summer of 1950 under very adverse conditions, involving cold weather and deep snow. In 672 man days, nearly 500,000 gross acres were surveyed. This was the foundation upon which was built the 1950 Control Program.

When these surveys terminated, those needed for planning control in 1951 were started. The new surveys began in August and ended in October. Over 2,800,000 gross acres were covered in 1,747 man days. They delineated epidemic areas and provided estimates of numbers of trees for use in planning and carrying out the 1951 Control Program.

As an aid to the Bureau of Entomology and Plant Quarantine and to obtain planning and operational data not otherwise available, the Forest Service also conducted check surveys in all infestations located in 1950, plus untreated infestations in the West Lake and Rabbit Ears areas.

The results of surveys of 1949 and 1950 attacks are shown on a tabulation opposite the 1950 Survey Map.

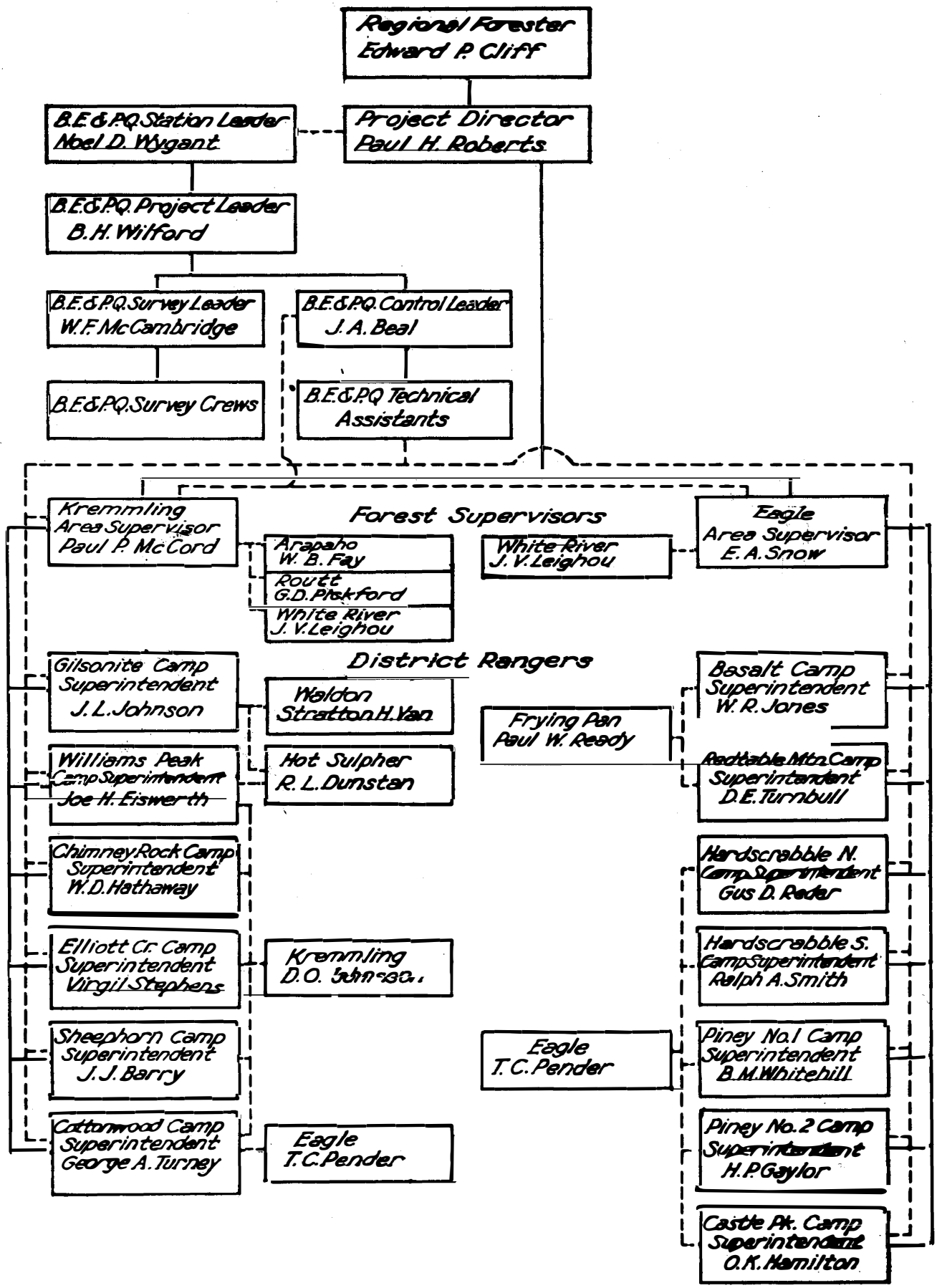
AERIAL PHOTOGRAPHS

From the time 1949 surveys started until late in the summer of 1950, the Project was handicapped by inadequate and inaccurate maps, both as to base and timber types. A little less than one-third of the area involved had adequate base maps, and very little was accurately typed. It was necessary to piece together 15 minute quadrangle maps at 2" to 1 mile scale for use by the Bureau of Entomology and Plant Quarantine survey crews and later by Forest Service control crews from anything that was available. Both insect surveys and control were handicapped, but most effect was on surveys where inaccurate information on type location and area was reflected in accuracy of survey estimates.

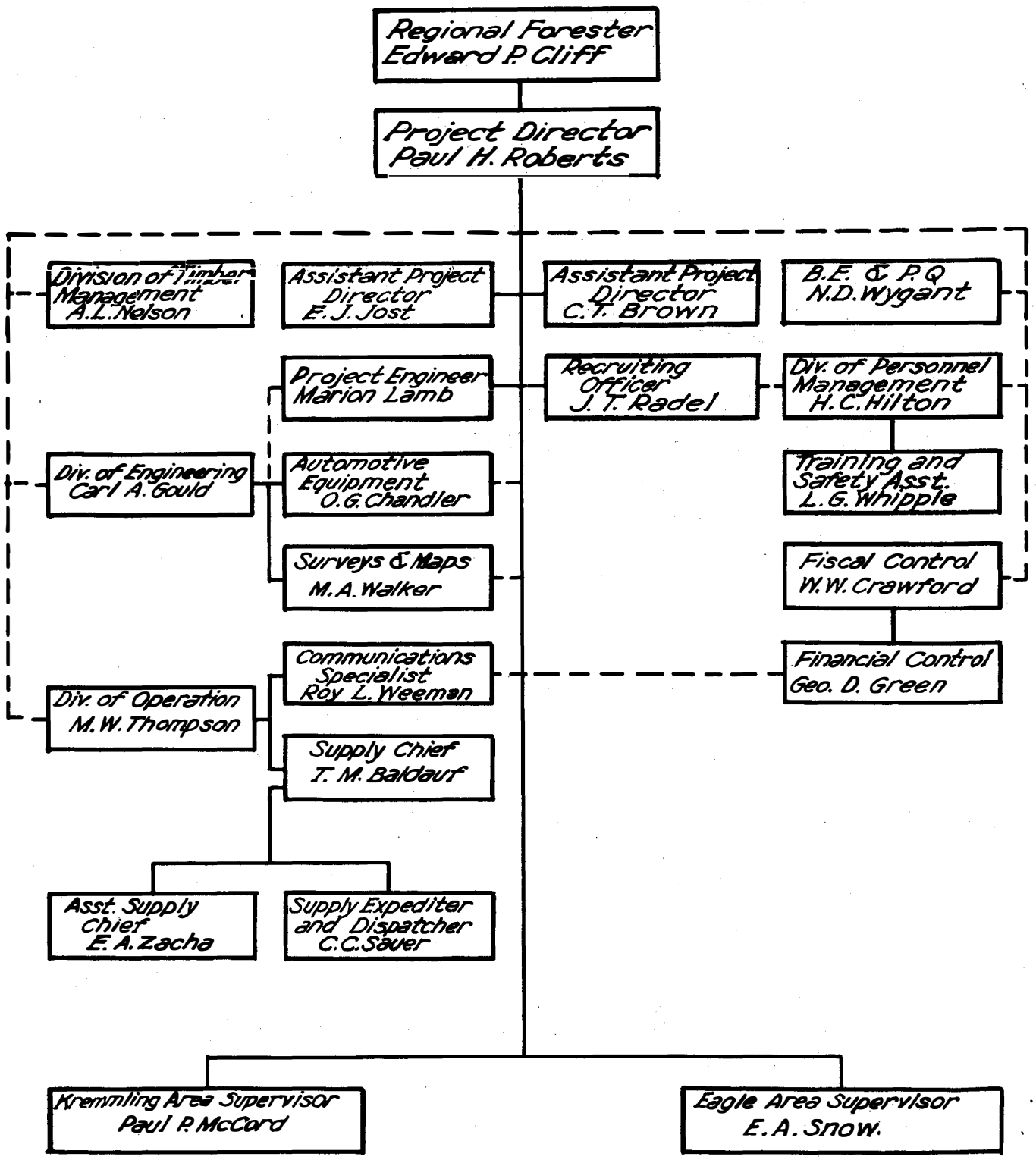
As soon as adequate Project funds became available, work was started by the Forest Service on constructing accurate planimetric base maps from existing satisfactory photography, and contracts let for obtaining the necessary additional photography. Ground control had been done for the entire area immediately threatened by the spruce beetle. Oblique aerial photographs taken during the spring and summer of 1950 proved to be very valuable for road location and general planning.

Miscellaneous vertical aerial photographs were taken of areas where Project roads were constructed. These photographs were used in transferring roads to planimetric maps.

MASTER ORGANIZATION CHART

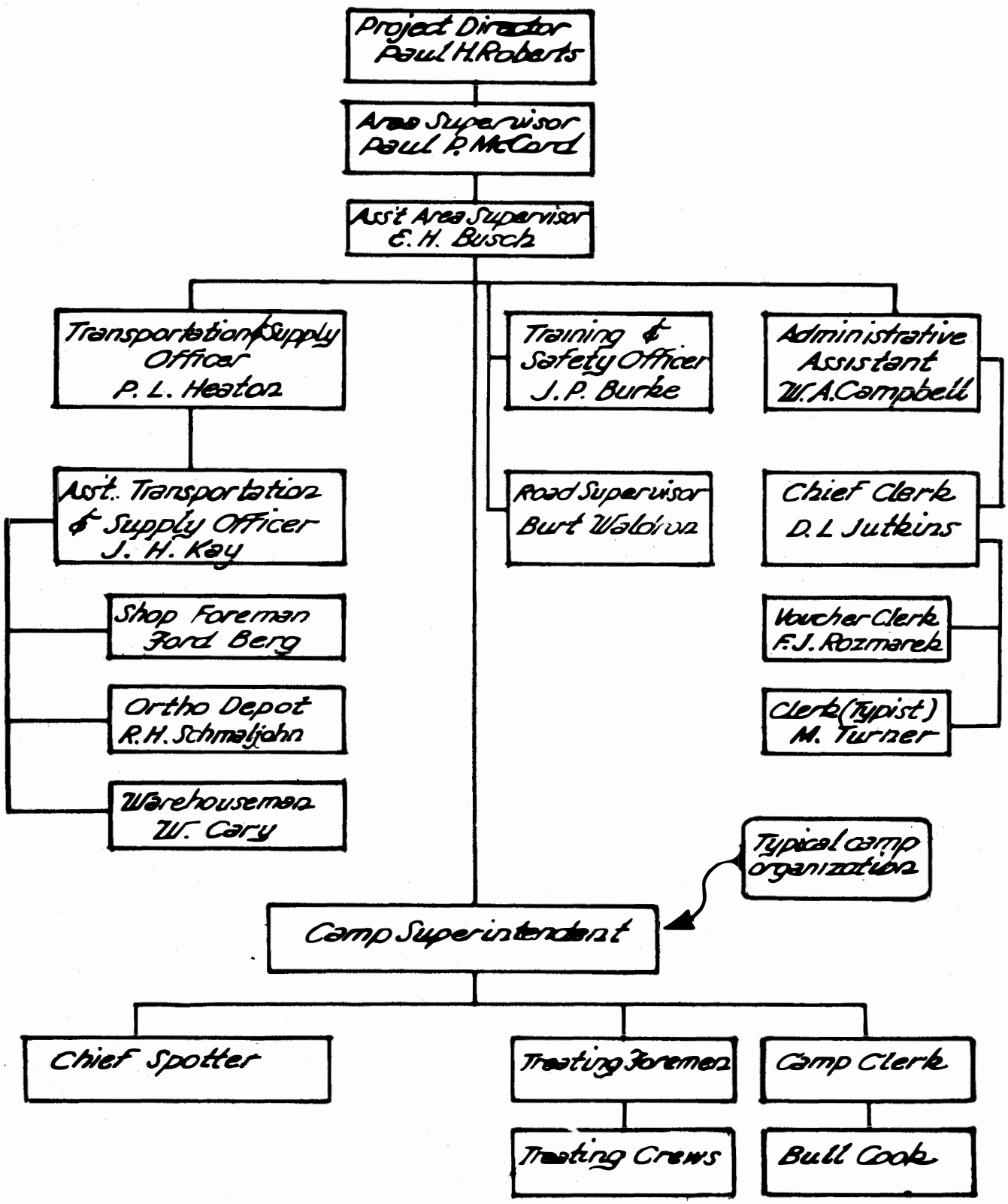


PROJECT DIRECTORS OFFICE
ORGANIZATION CHART



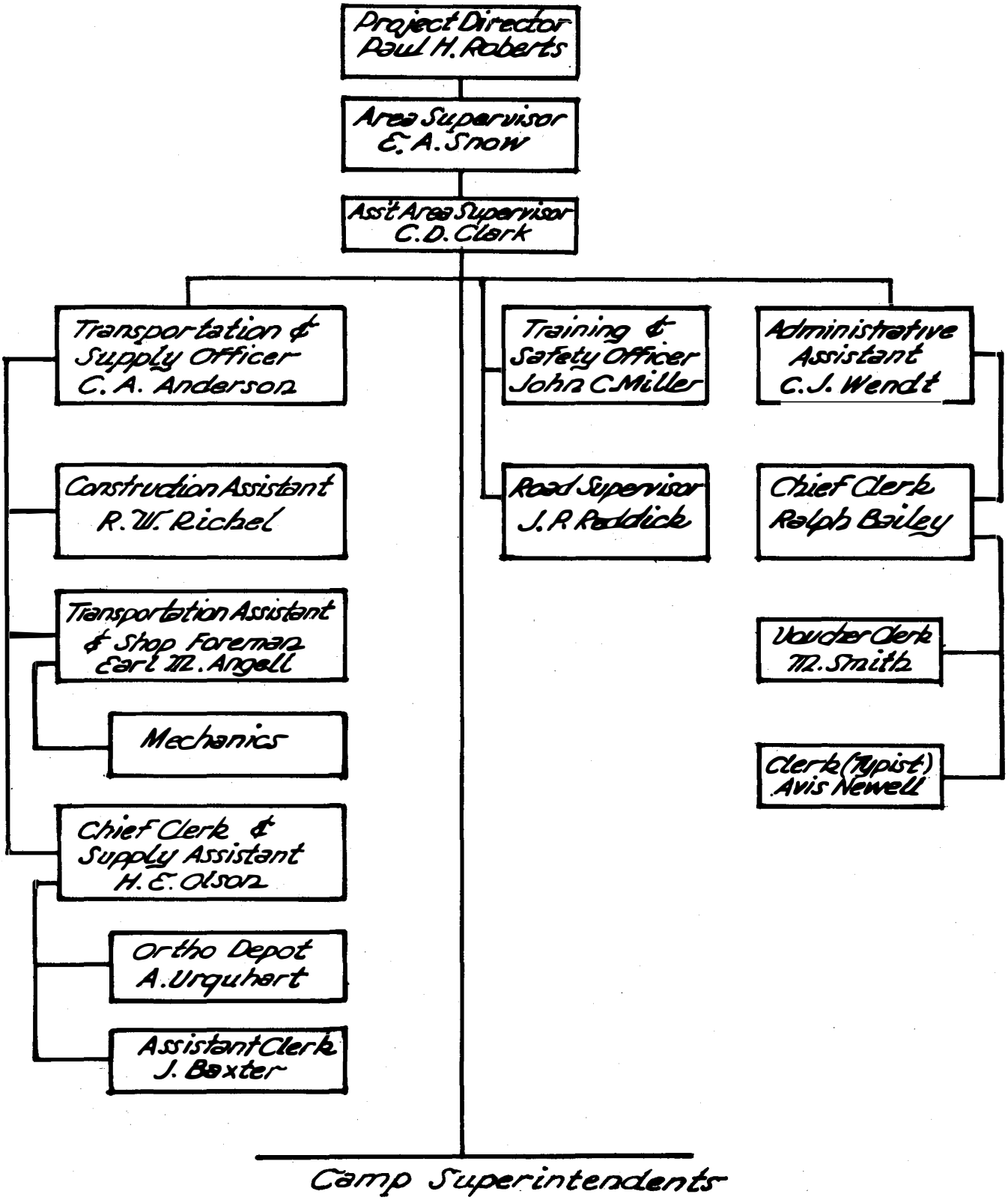
R.F.B. 12-20-50

KREMMLING AREA HEADQUARTERS OGANIZATION CHART



Rev'51

EAGLE AREA HEADQUARTERS ORGANIZATION CHART



PERSONNEL

Supervisory and facilitating personnel were detailed from all regions except 5 and 10. The September 15 personnel roster shows the following numbers of detailers and their parent regions:

No. of Detailers by Regions

	1	2	3	4	6	7	8	9	Totals
Director's office	3	19		1	1			1	25
Areas	3	37	1	3	1	1	2	7	55
Totals	6	56*	1	4	2	1	2	8	80

*Nine other regular appointees worked, when necessary, for short periods.

Temporary employees were recruited from forest schools and other colleges and universities, local labor within the work areas, some voluntary drift to the work areas as the Project gained publicity, recruitment from the general Denver area, and Indians - largely Navajo with a few Hopis.

The quality of labor was generally good, although the Project entered the employment field too late to command the best. College and university men were generally of high quality. This was the principal source of spotters, chief spotters, and treating foremen. Local men ranked next and furnished a fair sprinkling of supervisory personnel. Labor obtained from drifters and recruitment in the Denver area was the poorest. The men were not always physically or psychologically adapted to working in high mountain areas and rough terrain, were generally improperly equipped with clothing, and turnover was high.

Turnover was high among the college and university men near the end of the season, since many of them were returning to school. Many of them were required by their parents to quit work when they had earned just under $500.00 so they would not be lost as dependents for income tax purposes.

A total of 2,514 temporary persons were employed. The highest number on the Project rolls was 928 on September 2. For the payroll period ending September 16, there were 1,317 employees payrolled; yet, there were only 810 employees on the rolls as of September 16.

The Indians saved the day in the final weeks of the Project. They proved to be good workers if properly trained. The greatest drawback to their use was that they quit in large numbers near the end of the Project for apparently trivial reasons.

Rates of pay were established at $9.20 for Insect Laborer I, $10.00 for Insect Laborer II, and $10.80 for Straw Boss. The $10.00 rate was used for practically all labor, and only very few were employed at the $9.20 rate at the beginning of the Project. The $10.80 rate was used for nozzlemen. Subsistence deductions were made on all temporary employees at the rate of $2.85 per day. No employment difficulties were attributable to the above wage rates.

It was quite difficult to find and hold satisfactory camp clerks at the entering rate for GS-3, which was authorized for this position.

Mechanics were unobtainable for temporary hire at the approved rates, and the need could only be met by detailing regular Forest Service employees.

Truck drivers were difficult to obtain and hold at authorized rates, since private contractors in the vicinity were paying higher rates.

PERSONNEL ROSTER - INSECT CONTROL PROJECT

(As of September 15, 1950)

Region 1

Name	Position
Angell, Earl M.	Equipment Inspector (Eagle)
Jost, E. J.	Assistant Director (Regional Office)
Richel, Robert W.	Supply Assistant (Eagle)
Roberts, Paul H.	Director (Regional Office)
Waldron Burt	Roads (Kremmling)
Zacha, Edward A.	Asst. Supply Chief (RO-Central Purchase)

Region 2

Anderson, C. A.	Transportation and Supply (Eagle)
Baldauf, Tony	Supply Chief (Regional Office)
Beckman, J. H.	Spotter (Eagle)
Berg, Ford E.	Shop Foreman (Kremmling)
Brown, C. T.	Assistant Director (Regional Office)
Burke, J. P.	Training and Safety (Kremmling)
Busch, E. H.	Asst. Area Supervisor (Kremmling)
Campbell, W. A.	Administrative Assistant (Kremmling)
Chandler, O. G.	Equipment Inspection (Regional Office)
Clark, C. D.	Assistant Area Supervisor (Eagle)
Colwell, R. G.	Clerk (Eagle)
Eiswerth, J. H.	Camp Superintendent (Kremmling)
Feifer, Leon	Clerk (Eagle)
Ferguson, Morris D.	Roads (Regional Office)
Fiebelkorn, Carl	Spotter (Kremmling)
Garrison, J. A.	Shovel Operator (Eagle)
Gaylor, H. P.	Camp Superintendent (Eagle)
Grimes, Irene	Secretary to Director (Regional Office)
Gibson, D. E.	Clerk (Kremmling)
Hathaway, W. D.	Camp Superintendent (Kremmling)
Heaton, P. L.	Transportation and Supply (Kremmling)
Jones, W. R.	Camp Superintendent (Eagle)
Kay, Joseph H.	Supply Assistant (Kremmling)
Knoblock, A. F.	Spotter (Kremmling)
Lamb, Marion	Project Engineer (Regional Office)
Lavengood, G. W.	Surveys and Maps (Regional Office)
Lee, H. F.	Mechanic (Eagle)
Lindley, Ed	Roads (Kremmling)
MacMackin, C. A.	Photo. Interpreter (Regional Office)
McCord, Paul P.	Area Supervisor (Kremmling)
Miller, John C.	Training and Safety (Eagle)
Miller, John F.	Mechanic (Eagle)
Nance, Ellene	Clerk (RO-Central Purchase)
Radel, J. T.	Recruitment Officer (Regional Office)
Reddick, J. P.	Road & Trail Engineer (Eagle)
Reder, Gus D.	Camp Superintendent (Eagle)
Roeser, J. R.	Photo. Interpreter (Regional Office)
Rouillier, N. E.	Photo. Interpreter (Regional Office)
Rozmarek, F. J.	Voucher Clerk (Kremmling)

Region 2 (continued)

Sauer, C. C.	Supply Expeditor (Regional Office)
Saunders, Roy	Road and Trail Locator (Eagle)
Schmaljohn, R. H.	Roads (Kremmling)
Smith, Jay	Roads (Kremmling)
Smith, Ralph A.	Camp Superintendent (Eagle)
Snow, E. A.	Area Supervisor (Eagle)
Stringfellow, Roy	Roads (Eagle)
Swigert, R. E.	Spotter (Kremmling)
Turnbull, D. E.	Spotter (Eagle)
Walker, Matt	Surveys and Maps (Regional Office)
Wendelin, A.	Surveys and Maps (Regional Office)
West, V. W.	Draftsman (Regional Office)
Wheeler, L. G.	Clerk (Kremmling)
Whitehill, B. M.	Camp Superintendent (Eagle)
Whipple, L. G.	Safety & Training Officer (Regional Office)
Wilsey, Francis E.	Warehouseman (Regional Office)
Wyman, E.	Surveys and Maps (Regional Office)

Region 3

Bolden, Ralph	Mechanic (Eagle)

Region 4

Birkmeyer, E. A.	Asst. Supply Chief (RO-Central Purchase)
Hill, E. L.	Administrative Assistant (Kremmling)
Jutkins, D. L.	Chief Clerk (Kremmling)
Opheikens, Bert H.	Chief Clerk (Kremmling)

Region 6

Bailey, R. E.	Chief Clerk (Eagle)
Wilson, Richard C.	Photogrammetry (Regional Office)

Region 7

Seitz, C. C.	Road Locator (Eagle)

Region 8

Quam, A. N.	Road Locator (Eagle)
Thomas, Paul O.	Road Locator (Eagle & Kremmling)

Region 9

Barry, J. J.	Camp Superintendent (Kremmling)
Green, Geo. D.	Financial Manager (Regional Office)
Humm, Mitchell E.	Mechanic (Kremmling)
Kemper, Robert A.	Mechanic (Eagle)
Olson, Harold	Clerk (Eagle Depot)
Stephens, Virgil	Camp Superintendent (Kremmling)
Turney, G. A.	Camp Superintendent (Kremmling)
Wendt, Carl J.	Administrative Assistant (Eagle)

Washington Office

Berry, Wilbur E.	Photo. Interpreter

TRAINING

A 3-day training session was held at both Basalt and Gilsonite camps in late June. All supervisory personnel who were on the Project at that time and who could be spared from other duties attended one or the other of these camps.

Training at these camps was a joint effort of the Bureau of Entomology & Plant Quarantine and the Forest Service. It consisted primarily of background information on the infestation, followed by field instruction in the methods and techniques of spotting and treating, and safety training. The greatest handicap to this initial group training was that the methods and techniques of spotting and treating taught were greatly modified during the course of the Project.

Even though limited as to scope of training given and attending personnel, the effects of these 2 training sessions were felt throughout the Project. As new camps were established, a few of the trainees were transferred to them and formed the nucleus around which training was spread to all treating crews and supervising personnel.

A training and safety officer was assigned to the staff of each area supervisor and was responsible for the proper training of new crews. All training was headed up in the Project Director's office by the Regional Training and Safety Officer. Special attention was given to training newly-employed labor in treating techniques and safety practices during their first few days in camp. The large labor turnover caused this training to be a continuous process until the close of the Project.

Training of Indians was especially important. They learn fairly quickly but are apt to adopt, and refuse to abandon, inacceptable practices unless great care is used at the very outset to see that they are shown only the correct way of doing things.

SAFETY

Safety training was emphasized in the initial stages of the Project and was continued throughout the summer. During June, July, and August, the statistics available on injuries indicated that while the safety record for the Project would not be outstanding, it would be reasonably satisfactory for an emergency operation of this nature. During September and October, however, numerous delayed reports were received which completely changed the record.

It will be noted that more than half of the injuries reported on the Project occurred in September. Factors which contributed to this occurrence are believed to be:

1. With return to school of high school and university men, there was a distinct change in the overall type of employees to older men and Indians, who appeared to be more susceptible to injury.

2. On-the-ground working conditions during September were much more hazardous than during the early part of the season because of slippery conditions resulting from snow, rain, and freezing temperatures.

3. A possible involuntary let down in safety training as the result of the apparently good record during the early part of the season.

The value of prompt and accurate reporting procedure was emphasized by experience in safety on this Project. The actual number of lost time injuries occurring for the period June through November is shown in the tabulation below. The number of injuries initially reported by the two areas, however, was as follows: June - 2, July - 0, August - 3, September - 8. The result of this delay in reporting injuries was that in late September and in October, when remedial action was impossible, it became apparent that the safety record on the Project was much less favorable than had been expected.

Safety Record

Month	Cumulative Man-Hours	No. Lost Time Injuries		Cumulative Frequency Rate
June	19,559		3	153.38
July	150,347	(1)	4	26.60
August	357,428	(6)	10	27.98
September	497,039	(12)	22	44.26
October	550,669		22	39.95
November	601,704		22	36.56

RELATION TO FIRE CONTROL

It was agreed that Project crews would not be considered as a primary fire fighting force, but that they could be called up to suppress local fires originating with 45 minute travel time of camp. Except for such local fires, Project crews would not be called upon for small fires, unless by agreement between the area supervisor and forest supervisor, or for Project fires, unless requested by Region 2 Chief of Fire Control and agreed upon by the Project Director. Project crews were to be released from all fires before any other personnel on Forest Service payrolls. All expenditures in connection with fire suppression were paid from FF, unless less than 1 hour was involved, in which case the expense was paid from Project funds. Forest supervisors furnished a 10-man fire tool cache for each camp.

In spite of an unusually dry season, there was little interruption to Project work on account of fire suppression. No attempt was made to maintain accurate records of the extent to which Project personnel assisted on fires, but there were less than 800 man hours on 6 fires.

A. DIRECTOR'S OFFICE

1. Overhead

a.	Salary - Director and Staff	$ 22,751	
b.	Travel and equipment use - Director and Staff	6,712	
c.	Salary - Travel, Clerks (except Central Purchase)	12,137	
d.	Salary - Travel, Other Regional Office	1,703	
e.	Communication, ~~equipment~~ supplies	7,123	
f.	Planning prior to 5/29/50	15,524	
g.	Pictures by Washington Office	2,500	
	Subtotal - Overhead		$ 68,450

2. Facilitating Services

a.	Salary - Travel, Clerks, Central Purchase	$ 9,210	
b.	Surveys - Maps	11,000	
c.	Warehouse	7,640	
d.	Personnel - recruitment	6,130	
	Subtotal - Facilitating Services		$ 33,980
	Total - Director's Office		$ 102,430

B. AREA SUPERVISOR'S OFFICE

1. Overhead

a.	Salary - Area Supervisor & Staff	$ 42,680	
b.	Travel and equipment use - Area Supervisor & Staff	16,584	
c.	Salary - Travel, clerical force	20,428	
d.	Communication, rents, equipment	11,258	
	Subtotal - Area Supervisor		$ 90,950
	Total - Director & Area Supervisor		$ 193,380

C. CAMPS

1. Overhead

a.	Camp Superintendent, Clerk & Bull Cook	$ 43,600	
b.	Travel Expenses, on the job	3,550	
c.	Travel Expenses, to and from - detailers	925	
	Subtotal - Camp Overhead		$ 48,075

2. Direct Expenses

a.	Equipment operation, repairs and rentals		$ 149,540	
b.	Road construction & betterment		229,000	
	(1) Road maintenance		22,300	
c.	Construction Ortho Depots		12,750	
d.	Operation Ortho Depots		46,720	
e.	Insecticide (incl. freight)		133,190	
f.	Mixing and delivery of Ortho		113,900	
g.	Construction, operation - camps		798,600	
	(1) Construction	$165,850		
	(2) Mess - (Salary deduct)	154,680		
	(3) Pack stock	22,830		
	(4) Other	455,840		
h.	Camp breakup, reconditioning and storage		25,700	
	Subtotal - Camp Direct Expenses			$1,531,700
	Subtotal - Camp Expenses			$1,579,775
	Grand Total - All Expenses			$1,773,155

Notes on "Weekly Production by Individual Camps" Report

Variation in man-day tree production by areas is the result of an accumulation of several factors. Items such as the number of trees per acre, tree diameter, height, and time of season have a direct influence as to the amount of insecticide required. Topography and tree location such as large group or scattered creek bottom type, determine the amount of road mileage needed, cost per mile for construction and delivery cost of insecticide to treating area. These factors also influence methods of insecticide delivery to individual trees, time involved in treating, and size of crew required, all of which have a direct bearing upon the efficiency of crews and their daily tree production.

Kremmling Area

Gilsonite - Creek bottom stringers widely scattered. Large diameters.
Chimney Rock - Creek bottom stringers and small concentrated groups widely scattered. Average woodpeckers and diameters.
Elk Mountain - Scattered stringers and groups - not so widely scattered as above. Average woodpeckers and diameters.
Williams Peak - Scattered stringers - very heavy woodpecker work resulting in lower goop consumption and relatively higher production. Smaller than average diameters.
Elliott Creek - Small to large groups scattered over a wide area. Average woodpeckers and diameters.
Sheephorn - Large area with fairly uniform infestation. Woodpeckering slightly above average. Diameters slightly above average.
Cottonwood - A little more scattered than Sheephorn. Average woodpeckers and diameters.

Eagle Area

Basalt - Entire area worked was covered with loose basalt boulders, trees scattered, windfalls throughout area, woodpeckering moderate, medium to large diameters, road and trail construction very difficult.
Hardscrabble - Trees concentrated in large groups, ground conditions favorable, no excessive slopes, average woodpeckering medium diameters, road construction easy.
Piney - Scattered trees, with some concentrated groups, ground conditions good, road construction easy. Some steep slopes and windfalls. Woodpecker work light, medium to large diameters.
Castle Peak - Large concentration of trees of small diameters, ground conditions fair with numerous bogs and wet places, road construction difficult due to wet ground, woodpecker work light.
Red Table - Scattered groups, large diameters with resulting heavy use of Ortho, ground conditions in area treated good, road construction easy. Woodpecker work light.
West Lake - Stream bottom, with scattered trees on hillsides, road construction difficult, ground conditions fair. Woodpecker work medium.
Minturn - Small concentration including stump infestation in logging area, ground steep, diameters large.

1950 WEEKLY TREATING PRODUCTION BY INDIVIDUAL CAMPS
to September 30

Camp	Date Camp Est.	July 29	Aug. 5	Aug. 12	Aug. 19	Aug. 26	Sept. 2	Sept. 9	Sept. 16	Sept. 23	Sept. 30	Total Trees Treated	Tot. Camp Man-Days less Cooks & Flunkies	Average Per Camp Man-Day
Gilsonite	6/22	3,729	1,003	1,282	1,871	2,116	1,917	2,137	1,158	1,114	1,295	17,622	3,337	5.3
Chimney Rock°	7/7	9,183	2,789	2,041	3,249	3,767	4,399	774	Moved to Elk Mtn.			26,202	3,270	6.6
Sheephorn	7/13	12,183	6,612	8,201	7,870	7,578	7,434	6,239	6,125	12,176	11,663	86,081	4,969	17.3
Cottonwood	7/25	2,146	4,437	5,214	5,278	4,219	6,911	8,461	3,482	3,734	5,734	49,616	3,502	14.1
Elk Mountain	9/6							1,700	960	2,691	5,370	10,721	1,329	8.0
Sheephorn East	9/27										3,949	3,949	656	6.0
Elliott Creek	7/22	2,317	3,575	2,259	2,936	3,300	5,339	3,146	1,728	1,435	862	26,897	3,221	8.3
Williams Peak	8/1		1,960	2,726	5,814	4,524	4,221	3,819	3,334	4,133	1,021	31,552	2,337	13.5
Total Kremmling:		29,558	20,376	21,723	27,018	25,504	30,221	26,276	16,787	25,283	29,894	252,640	22,621	11.17
Basalt	6/19	6,680	2,014	2,650	3,040	3,273	2,983	1,360	2,011	1,319	262	25,592	2,825	9.0
Hardscrabble N.	7/18	6,647	8,009	10,326	10,633	7,953	9,109	12,350	12,133	18,232	7,936	103,328	4,298	24.0
Hardscrabble S.	7/11	12,595	6,232	5,343	7,740	11,746	9,019	13,000	8,791	11,736	16,683	102,885	4,921	20.9
Piney #1	7/5	9,784	4,530	5,866	5,507	4,578	6,501	3,620	955	4,279	9,078	54,698	4,828	11.3
Piney #2	7/24	1,402	2,353	4,793	5,033	3,629	4,316	5,676	3,736	6,394	3,707	41,039	3,188	12.9
Red Table	8/10			648	3,903	5,503	5,649	3,575	6,865	8,956	15,635	50,734	3,590	14.1
Castle Peak	8/27						17,212	22,486	24,194	13,087	26,510	103,489	2,710	38.1
Total Eagle		37,108	23,138	29,626	35,856	36,682	54,789	62,067	58,685	64,003	79,811	481,765	26,360	18.3
GRAND TOTAL		66,666	43,514	51,349	62,874	62,186	85,010	88,343	75,472	89,286	109,705	734,405	48,981	15.0

°Moved to Elk Mtn.

SURVEY OF 1949 ATTACKS

Area No.	Estimated Number 1949 Trees		
	1949 Survey	1950 Survey	Total
1	19,000	65,355	84,355
2	81,000	33,082	114,082
3	400,000	7,000	407,000
4	50,000	--	50,000
5	--	260,000	260,000
Total	550,000	365,437	915,437

Routt Natl. Forest

AREA NO. 4

State Forest

AREA NO. 1

To Craig

U.S. 40

Steamboat Springs

Rocky Mountain Natl Park

Arapaho Natl Forest

Arapaho N F

Outbreak Area outside of control area. Outbreak moving in northerly direction

Hot Sulphur Springs

US 40

Kremmling

Fraser

(Old outbreak No longer a source of infestation)

White River Natl Forest

AREA NO. 5

Arapaho Natl For.

Idaho Springs

To Denver

AREA NO. 2

US 6 & 24

Eagle

US 6

Dillon

To Grand Junction

Glenwood Springs

AREA NO. 3

White River Nat'l Forest

Basalt

Aspen

Leadville

To Salida

R-2

Forest Service

COLORADO SPRUCE BEETLE

1950 CONTROL PROJECT

(Survey of 1949 attacks)

Legend

Areas surveyed in 1949

Areas surveyed in 1950

Area Boundaries

GPO 82-9000113

See Reverse Side

TOTAL ACCOMPLISHMENT BY AREAS

Map No.	Infestation Name	1949° Attacks	1950 Attacks	Total	Remarks
Area No. 1					
5	Sherman Cr.	418		418	All 1949 trees treated.
7	Bill Creek	2,167		2,167	1950 infestation endemic
8	Parkview Mtn.	479	318	797	All 1949 & 50 trees treated.
13	Indian Cr.	20,469	4,326	24,795	All 1949 trees treated.
8A	Parkview Cr., E. Br. Willow Cr. & Willow Cr.	13,184	760	13,944	All 1949 trees treated All 1950 trees treated in Parkview Cr. & Portion E. Br. Willow Cr.
11A	Elk Mountain	10,360	412	10,772	All 1949 trees treated.
13A	Arapaho Cr.	1,567	100	1,667	" " " "
65	Fraser Exp. Station	160	136	296	All 1949 & 1950 trees treated.
	Total Area No. 1	48,804	6,052	54,856	
Area No. 2					
14	E. Cottonwood	114,394	18,038	132,432	All 1949 trees treated.
18	Elliott Cr.	28,655	3,928	32,583	" " " "
26	Cottonwood Peak	36,210		36,210	" " " "
30	Piney Guard Stn.	42,663	46,561	89,224	" " " "
25A	Williams Peak	31,552		31,552	" " " "
28A	Minturn	267	4,153	4,420	All 1949 & 1950 trees treated, in area worked.
	Total Area No. 2	253,741	72,680	326,421	
Area No. 3					
36&37	Hardscrabble Mtn.	144,137	62,076	206,213	All 1949 trees treated.
39	Red Table Mtn.	57,675	1,156	58,831	Only 1 camp established.
43	Basalt Mtn.	11,120	14,472	25,592	All 1949 trees treated.
31A	West Lake	90	2,003	2,093	Treating incomplete.
	Total Area No. 3	213,022	79,707	292,729	
Area No. 4					No work done, 1950.
Area No. 5					
64	Castle Peak	104,021	6,055	110,076	Treating incomplete.
	Total Area No. 5	104,021	6,055	110,076	
	Total All Areas	619,588	164,494	784,082	

°Includes a small number of 1948 attacks.

Routt Natl. Forest

State Forest

To Craig

U.S. 40

Steamboat Springs

13A

8A

13

8

7

15

Rocky Mountain Natl Park

Arapaho Natl Forest

Arapaho N F

11A

Hot Sulphur Springs

US 40

Kremmling

Fraser

White River Natl Forest

14

18

26

25A

Arapaho Natl For.

64

Idaho Springs

To Denver

30

28A

US 6 & 24

Eagle

US 6

Dillon

To Grand Junction

Glenwood Springs

36 & 37

31A

39

43

White River Nat'l Forest

Basalt

Aspen

Leadville

To Salida

R-2

Forest Service

COLORADO SPRUCE BEETLE

1950 CONTROL PROJECT

Legend

1949 Attacked trees treated

1949 & 1950 Attacked trees treated

FEW '50

See Reverse Side

1950 Survey of 1950 Attacks

Block	Name	Acres	1950 Infested Spruce	
Rabbit Ears				
1	Ficks Sawmill	10		330 stumps
2	Diamond Park	20	30	
3	Head of Gilpin Cr.	67	500	
4	Rabbit Ears	14,145	205,000	
Kremmling Area				
6	Chimney Rock	2,340	15,000	
7	N.W. of Hyannis Peak	57	210	
8	East Fork Arapaho Cr.	15	30	
9	Head of Coyote Cr.	50	90	
10	N.E. of Bundy Lakes	65	380	
11	Head of Buffalo Cr.	38	130	
12	Head of Rock Cr.	13	20	
13	Head of Willow Cr.	4,500	2,000	
14	Radial Mountain	34	70	
15	Little Jack Cr.	1,090	800	
16	Bowen Gulch	40	120	
17	Bennay Mountain	1,280	1,300	
18	Elk Mountain	1,200	14,000	
19 A	Fool Cr.		470	
19	Beaver Cr.	304	1,400	
20	Strawberry Cr.	33	800	
21	Kelly Cr.	4	50	
22	Little Muddy Creek	112	550	
23	Keyser Creek	185	2,000	
24	Williams Peak	2,700	33,000	
25	South Brush Creek	300	1,500	
26	Slate Lake	240	360	
27	Black Lake	200	1,200	
28	Surprise Lake	1,100	5,700	
29	Elliott Creek	4,400	46,000	
30	Cottonwood Peak	7,500	252,000	
Eagle Area				
31	Slate Mountain	628	5,600	
32	Red Sandstone			4,000 stumps
33	Middle Cr. - Spraddle Cr.	157	720	
34	Red & White Mountain	7,360	137,000	
35	Head of Game Creek	40	1,000	
36	Two Elk Cr.	3	80	
37	Head of Willow Cr.	130	430	
38	Benson's Logging Op.			1,400 stumps
39	Hornsilver Mountain			350 stumps
40	Grouse Lake	1,176	8,300	
41	Middle Lake	5,793	22,100	
42	Porphyry Mountain	4,144	13,000	
43	Salt Creek	100	2,000	
44	Hat Creek	1,745	3,400	
45	West Brush Creek	407	6,500	
46	Hardscrabble Mountain	2,500	98,700	
47	Red Table Mountain	16,372	476,000	
48	Basalt Mountain	1,500	18,000	
49	Kobey Park	1,000	500	
50	Thomas Lake	1,745	1,500	
51	Castle Peak	4,300	164,000	
	TOTAL	91,142	1,543,500	6,080 stumps

Compiled by: W.F. McCambridge, Entomologist
Bureau of Entomology & Plant Quarantine

Routt Natl. Forest

State Forest

Rocky Mountain Natl Park

Arapaho Natl Forest

Arapaho N F

White River Natl Forest

Arapaho Natl For.

To Craig

U.S. 40

Steamboat Springs

324,500 1950 infested Spruce

Outbreak Area outside of control area. Outbreak moving in northerly direction

Old outbreak (No longer a source of infestation)

Hot Sulphur Springs

US 40

Kremmling

Fraser

Idaho Springs

To Denver

US 6 & 24

Eagle

Glenwood Springs

To Grand Junction

Basalt

Aspen

Leadville

US 6

Dillon

To Salida

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 19A 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51

R-2

Forest Service

COLORADO SPRUCE BEETLE

1950 CONTROL PROJECT

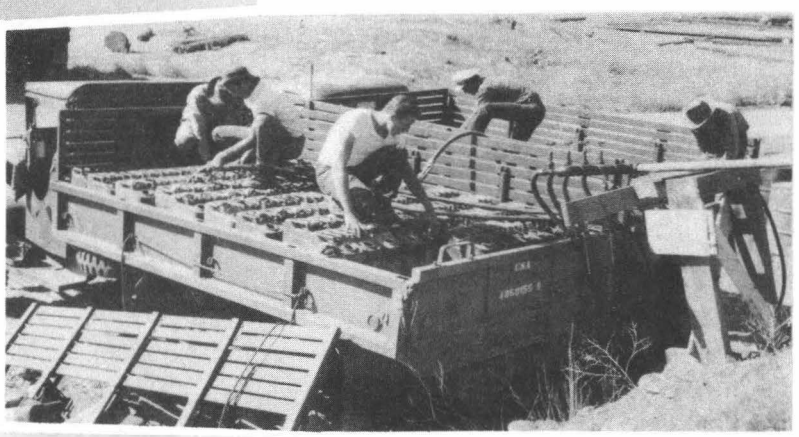
Legend

14 Outbreak areas where control is recommended in 1951

FEB '50

PLATE I

Kremmling Ortho Depot. Three 5,000 gallon tanks interconnected with outlet pipes. The pipe extending to left goes to lower level, the end of which is shown in next picture.



Jeep cans in bed of truck were filled from the hoses and shutoff valves, as shown.

One man could operate 2 valves, while another man was kept busy unscrewing tops and later replacing them on filled cans.

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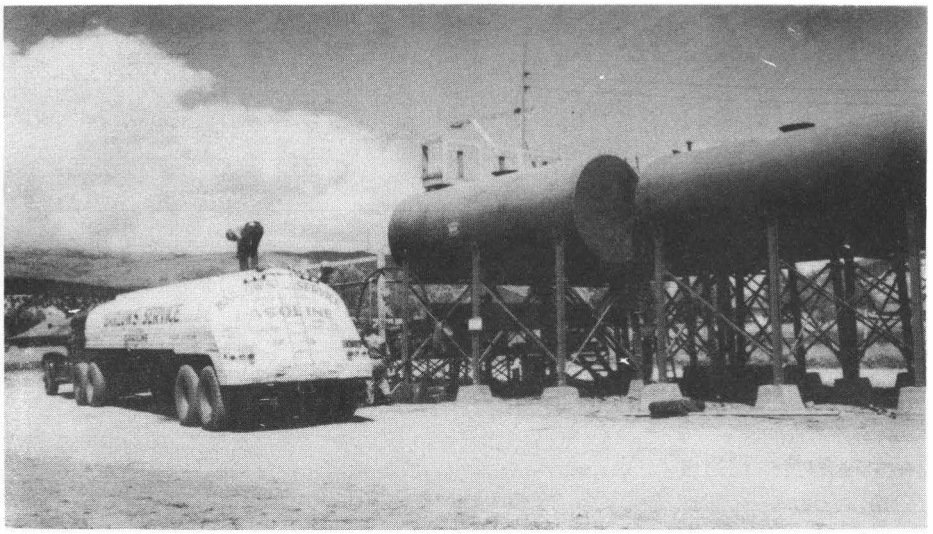
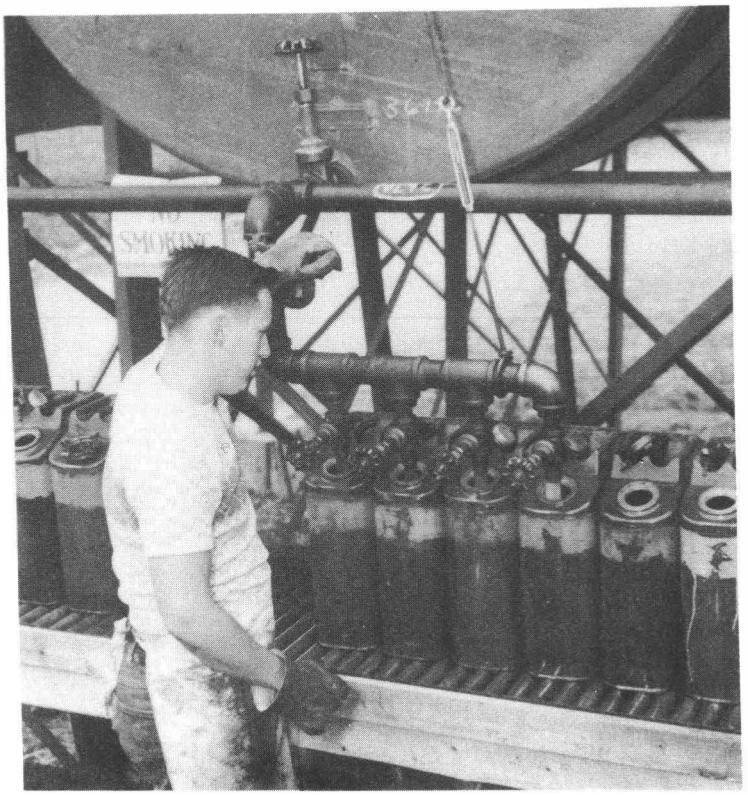
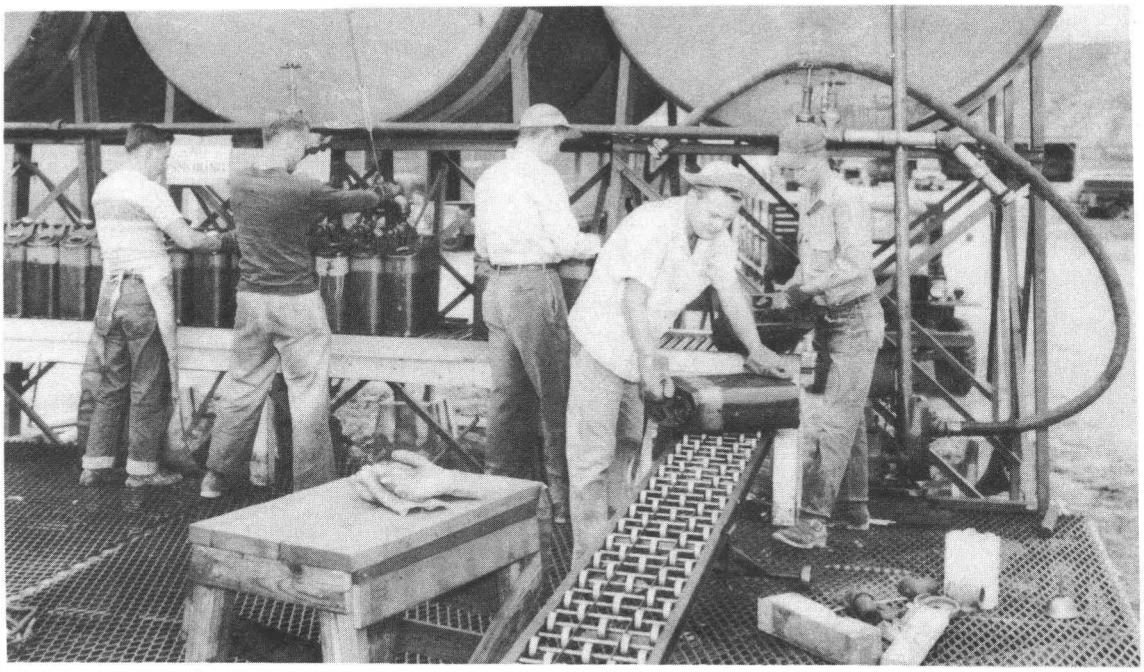


Eagle Ortho Depot. Commercial tank truck unloading ortho into field storage tank. Gasoline pump forces mixture into interconnected bank of five 5,000-gallon storage tanks.

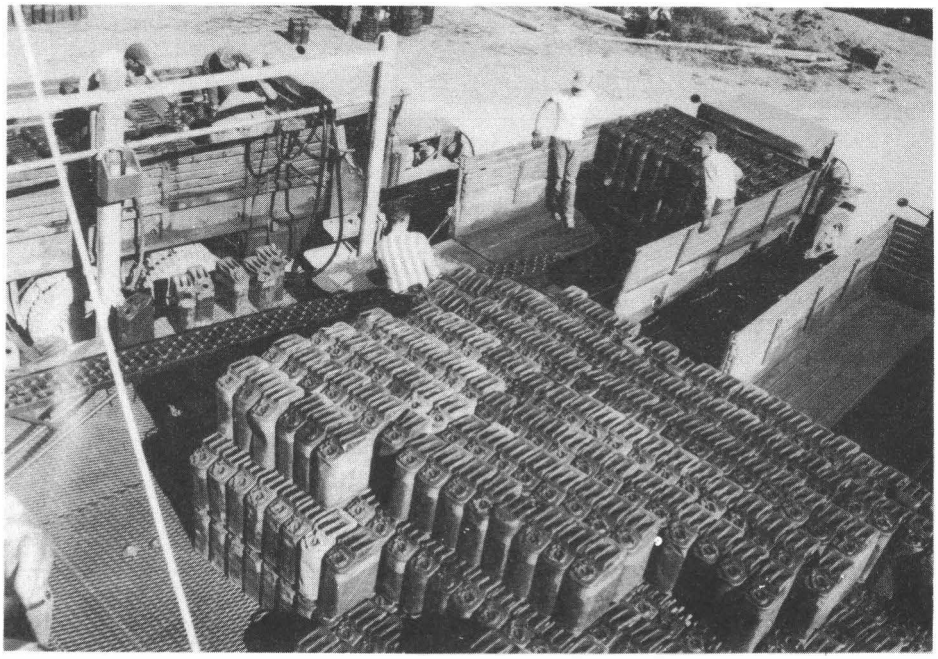


Filling 4 jeep cans through a manifold arrangement of valves.

GPO 82-900•120



Eagle Ortho Depot arrangement. Conveyor in foreground extends to truck being loaded as shown in next picture. Note pump at right on end of hose which connects to tank truck being unloaded.



Truck loading at Eagle Ortho Depot - one from conveyor and one from hose and nozzles at left of platform. Empty jeep cans in center.

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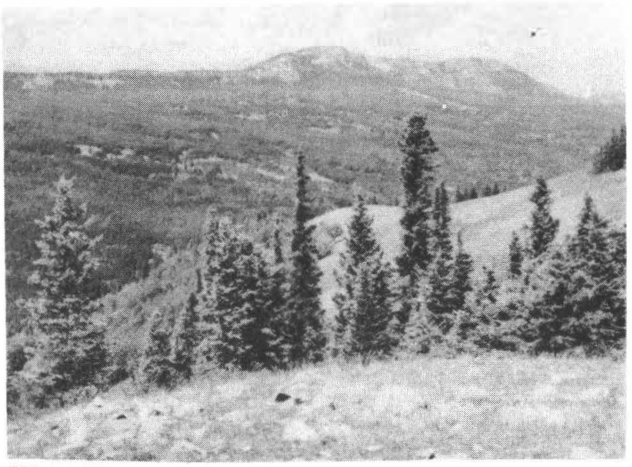
PLATE IV

Looking across the Cottonwood treating area. Slope in foreground had approximately 170,000 - 1949 attacked trees treated from 3 camps.



Constructing treating road with heavy trail builder equipment. Clearing was done with this equipment as shown in this photograph.

A completed main access road. 145 miles of these roads were constructed and 48 miles bettered, and in addition, 195 miles of jeep roads were built.

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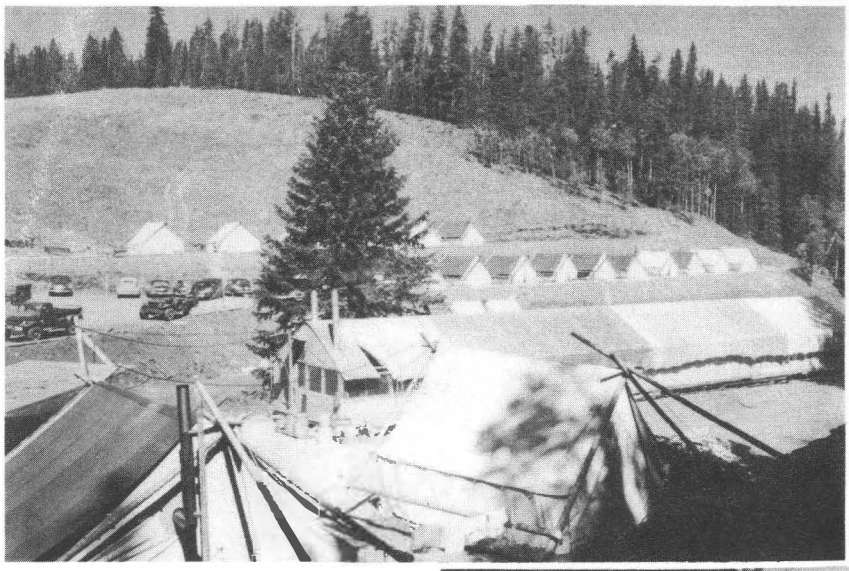
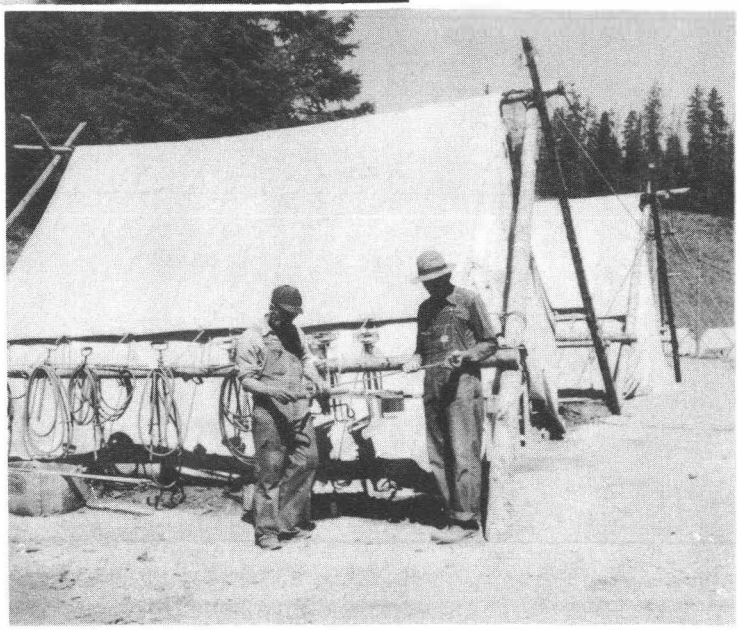
A typical camp layout. Bathhouse closest building. Crew tents in background.



Looking across Hardscrabble North camp. Long building is mess hall. Note outside electrical cords connecting each tent.

Repairing pump equipment at Hardscrabble North camp.



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Field Ortho dump. Cargo trucks unload at these field stations. Crew pick up cans with weapon carriers, jeeps or horses for delivery to treating areas. Orange colored bands on cans help to locate in woods.

Load of empty cans enroute to field ortho dump from treating area.

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PLATE VII

Loading jeep cans on horse. Note chains for quick fastening of cans to Decker saddle. Also protective mantle to keep ortho away from horse.

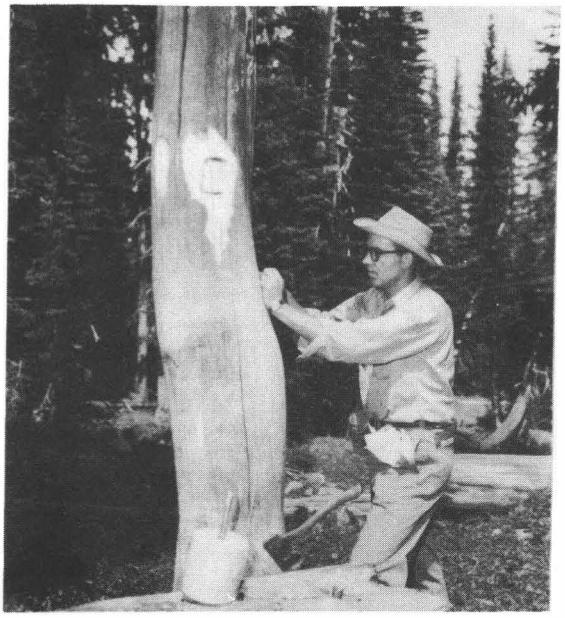
Leading loaded horse to treating area. Rope tied around cans holds them steady and shapes mantle to drain ortho away from horse's legs.

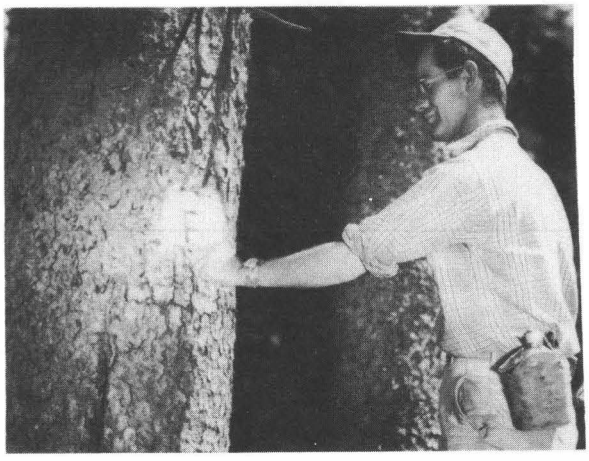
Weapon carriers loaded with treating crews ready to leave for work areas. Jeeps used for spotters, foremen and camp superintendents.

GPO 82-9000120

The type of trees attacked. A typical Engelmann spruce scene.

Laying string, the first job in treating an area. String lines are from 4 to 5 chains apart, with stations on string lines 10 chains apart.





Spotting trees. The "F" stands for "full treatment." If a tree is heavily attacked by woodpeckers a "W" would be used, which tells the treating crew to treat to woodpecker work. An "S" was used to designate "stump treatment."

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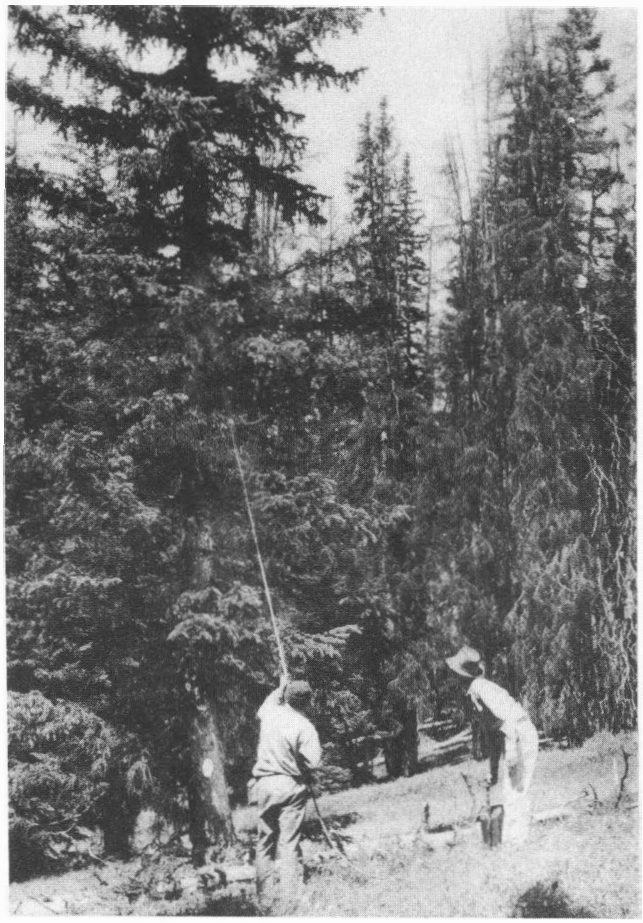
PLATE IX



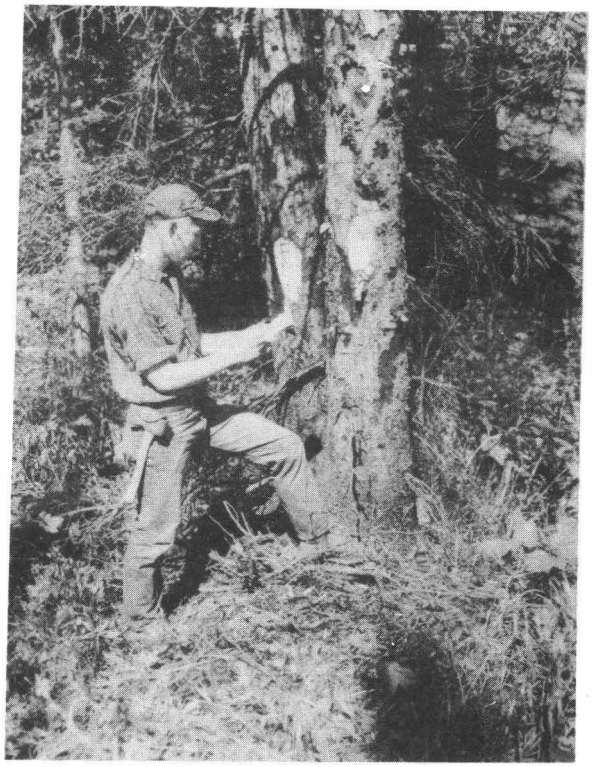
Treating crew starting to spray for full treatment. An aluminum rod 6' long extends from nozzleman's hands. Spray is traveling about 20 feet from end of road.

Treating the basal part of the tree - note the pumpman constantly watching the tree. He varies the pressure as needed.

GPO 82-9000120

The pumpman varies pressure as needed.

The treating crew, spotter-foreman, nozzleman showing shutoff valve and extension rod, and pumpman.



The treating foreman checking a treated tree. Note woodpecker work which removes bark.

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